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DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084

SEAWORTHINESS PREDICTIONS FOR TWO PRELIMINARY CSGN DESIGNS

by

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and

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SHIP PERFORMANCE DEPARTMENT

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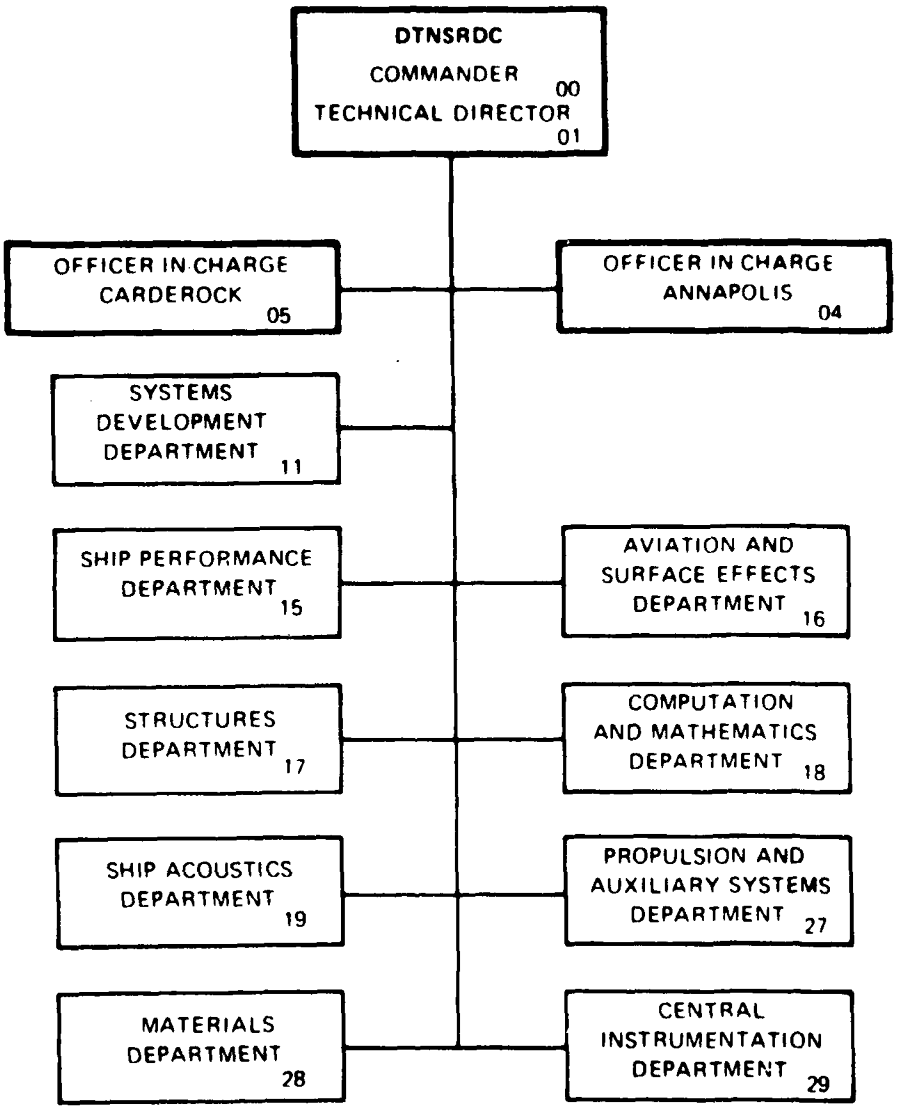

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The motions, velocities, and accelerations of two preliminary designs for a new class of nuclear-powered, guided-missile strike cruisers were predicted in regular waves and in long and short-crested seas. Important ship responses of the two hulls were compared for various sea conditions and ship heading angles. Results from the computer predictions are stored on computer permanent files for easy access and future use.

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ABSTRACT

The motions, velocities, and accelerations of two preliminary designs for a new class of nuclear-powered, guided-missile strike cruisers were predicted in regular waves and in long and short-crested seas. Important ship responses of the two hulls were compared for various sea conditions and ship heading angles. Results from the computer predictions are stored on computer permanent files for easy access and future use.

ADMINISTRATIVE INFORMATION

The work was conducted at the David W. Taylor Naval Ship Research and Development Center (DTNSRDC) with funding provided by the Naval Ship Engineering Center (NAVSEC) under Project Orders WR 66002 dated 14 May 1976 and WR 66313 dated 9 August 1976. The work is identified as Work Units 1-1568-863 and 1-1568-866.

INTRODUCTION

Two hull form designs have been proposed for a new class of nuclear-powered, guided-missile strike cruisers (CSGN). The two designs are quite similar; the most outstanding difference is that one, designated C24.2 or LWP, has a wide transom stern and large waterplane area whereas the other, designated C17.2 or conventional hull, has a more conventional shaped stern and waterplane area.

The purpose of this investigation is to establish a ship motion data base for the two designs.* The regular wave motions were predicted by using the DTNSRDC Ship-Motion and Sea-Load (SMSL) Computer Program.[1]

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*This rather complete documentation for the motions of these ships can be used now to evaluate the seaworthiness characteristics of the two designs and will be useful in the future to answer specific questions about these ships and ships of similar design.

[1] Meyers, W.G. et al., "Manual - NSRDC Ship-Motion and Sea-Load Computer Program." NSRDC Report 3376 (Feb 1975). A complete list of references is given on page 86.

DESCRIPTION OF HULL FORMS

The particulars for the two hull designs were furnished by NAVSEC in the form of body plans (from which offsets of individual ship sections had to be determined) and a listing of ship displacements, drafts, GM's, waterline, and length between perpendiculars and beams. The resulting principal dimensions of both designs as calculated from the ship offsets are shown in Table 1. Body plans of the conventional and the large waterplane designs, as used by the computer programs, are shown in Figures 1 and 2, respectively. Bilge keels are not shown in the computer body plans, but they were included in the mathematical model of the hull.

The computer-determined dimensions and form coefficients agreed very well with the design values. The calculated displacements of 16,866 and 16,850 long tons (17,136 and 17,120 tonnes) for the two hull designs differed by less than 2 percent from the design displacement of 17,172 long tons (17,448 tonnes).

As seen in the table, the two designs are the same except for transom width, waterplane area, and associated parameters. For example, the difference in the KM is related to the difference in transom width.

PREDICTION PROCEDURE

Ship responses were computed by using the CDC 6700 and the CDC 6400 computer systems available at the Center. All of the ship motion predictions are stored on two 844 removable disk packs titled CSGN01 and CSGN02.

Many computer programs were used to make the ship motion and statistics predictions presented in this report. Most of the major programs, as well as some of the smaller access programs, are documented and a reference for each will be given as they are discussed. The smaller programs necessary to access the data and not documented elsewhere are documented in the appendixes. Copies of the access programs are included on the disk pack. Instructions for accessing the disk pack stored data and programs are given in the appendixes or the reference for each program.

Computer program SMSL[1] was used in the first stage of the predictions to calculate the response amplitude operators (RAO's) of all six degrees of freedom (surge, sway, heave, roll, pitch, and yaw) for both hull forms. The range of ship speeds and headings for which calculations were made are indicated in Tables 2 and 3. The resulting output contains the RAO's for the motions listed in Section A of Table 4 and is stored on disk pack CSGN01.

The root mean square (rms) responses in various irregular seas were calculated in the second stage of the computation by the method developed by St. Denis and Pierson.[2] The ship locations and predicted motions are shown in Section B of Table 4. Bretschneider irregular sea[3] spectra of 1.0-ft significant wave height and modal wave periods of 7, 9, 11, 13, 15, 17, 19, and 21 sec were used in the prediction. Since ship responses are regarded as being linear with wave height in this work, the responses in seas with greater wave heights can be obtained by multiplying the results for unit significant wave height by the desired significant wave height in feet.

The modal wave period represents the period corresponding to the maximum energy or peak of the wave energy spectrum. The complete range of realistic modal periods was used in the calculations so that whatever modal period is required in the future, one close to it would be available.

The rms values for all conditions shown in Tables 2 and 3 were computed in both long- and short-crested seas by using a cosine square spreading function as recommended by Baitis et al.[4] All rms values are stored on the disk pack CSGN01 for future use.

For the third stage of the prediction, the rms values generated in the second stage were used to predict significant single amplitudes of motion

[2] St. Denis, M. and W.J. Pierson, "On the Motions of Ships in Confused Seas," Trans. Soc. Nav. Arch. Mar. Eng., Vol. 61, pp. 280-357 (1953).

[3] Bretschneider, C.L., "Wave Generation by Wind, Deep and Shallow Water," in "Estuary and Coastline Hydrodynamics," edited by Arthur T. Ippen, McGraw-Hill, Inc., (1966), pp. 133-196.

[4] Baitis, A.E. et al., "Design Acceleration and Ship Motions for LNG Cargo Tanks," presented at 10th Naval Hydrodynamics Symposium, Mass. Inst. Technol., Cambridge, Mass. (Jun 1974).

responses to the wave spectra most likely to occur in specific locations with significant wave height (double amplitudes) of 10.2, 16.9, and 30.6 ft (3.1, 5.1, and 9.3 m). A small computer program was written to predict the significant single amplitude of motion from the rms motion stored on the disk packs. Details of the program and its operation are given in Appendix A.

RELATIVE MOTION PREDICTIONS

At present there is no automated way by which the vertical motion of a point on the ship with respect to the water surface (relative motion) can be calculated from the results of computer program SMSL. Relative motion in head seas is an important consideration for most ships since it is used to predict the number of occurrences of deck wetness, bow or sonar window emergence, and keel slamming. Therefore, the DTNSRDC two-degree-of-freedom program, formerly called YF 17,[5,6] and now revised and referred to as the Pitch-Heave Motion (PHM) Program was used. The revised version has the same form of the heave force and pitch moment equations as the SMSL program and predicts pitch and heave motion values similar to those of the SMSL program. However, the PHM program also calculates the vertical relative motion at specified locations of the ship.

The PHM program was used to predict the vertical relative motion at Stations 0, 1/2, 1, and 3 for Bretschneider long-crested sea spectra of 1.0-ft (0.3 m) significant wave height and modal wave periods of 9, 11, 13, 15, and 17 sec and to store the rms values on disk pack CSGN02 for ship speeds from 5 to 30 knots in 5-knot intervals. A small program, called RED (see Appendix B), was written to enable the rms values to be used to calculate number of occurrences of deck wetness, sonar dome window emergence, and slamming by the method developed by Ochi.[7]

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[5] Frank, W. and N. Salvesen, "The Frank Close-Fit Ship Motion Computer Program," NSRDC Report 3289 (Jun 1970).

[6] Hubble, E.N. and J.B. Hadler, "Prediction of Ship Motions in Regular and Irregular Head Waves," NSRDC Departmental Report SPD-623-01 (Apr 1975).

[7] Ochi, M.K., "Prediction of Occurrence and Severity of Ship Slamming at Sea," presented at Fifth Symposium on Naval Hydrodynamics, Norway (Sep 1964).

MOST PROBABLE SEA CONDITION

The seas of particular interest for this ship are those most likely to occur in the North Atlantic during winter and to occur in any ocean around the world during any season. Hogben and Lumb[8] have compiled a large number of observed combinations of wave height and wave period for different ocean areas around the world and for each season of the year.

In the Hogben and Lumb data, Areas 1, 2, 6, 7, 8, 9, 10, 11, 16, 17, and 18 are included in an area defined for this prediction as the North Atlantic Ocean. This includes all of the Atlantic between 10 and 60 degrees North. These areas during the worst time of year (i.e., December, January and February) were considered as one statistical sample in determining the probability distribution and probability density functions of wave height for the winter North Atlantic.

Similarly, all the data from all areas for all seasons were considered as one statistical sample, and the probability distribution and probability density function of wave height were determined for the worldwide ocean for all seasons. Hogben and Lumb have a good wave height and period sample from most ocean areas over the world; however, no open-ocean data was included from the North Pacific Ocean. Waves in the North Pacific are generally longer than those of most other oceans of the world. However, the effect on wave height and period statistics of excluding the relatively few wave samples of the North Pacific from the relatively large wave sample in Hogben and Lumb is expected to be small. Both the worldwide all-season and the winter North Atlantic wave height probability functions and distribution functions are shown in Figure 3. It should be noted that the wave heights in this report are significant double amplitudes and when taken from observed wave heights as presented by Hogben and Lumb, are converted to and presented as actual significant wave heights by the method developed by Nordenström.[9] As seen

[8] Hogben, N. and F.E. Lumb, "Ocean Wave Statistics," Her Majesty's Stationery Office, London (1967).

[9] Nordenström, N., "Methods for Predicting Long Term Distributions of Wave Loads and Probability of Failure for Ships, APP II," Det Norske Veritas Research Department Report 69-22-S (1969).

in Figure 3, higher wave heights are more likely to occur in the winter North Atlantic than in the general ocean. Also, the significant wave height most likely to occur is about 2.0 m in both winter North Atlantic and worldwide areas. The probability that seas with greater significant wave heights will be encountered than those used in the motion prediction is shown in Table 5 for both the winter North Atlantic and the worldwide all-season operation.

Figures 4 and 5 show the conditional probability that a particular modal period will occur given that the seas have significant amplitudes of 10.2, 16.9, or 30.6 ft (3.1, 5.1, or 9.3 m). These sea conditions are referred to as Sea States 5, 6, and 7 for both operational areas. The probability of a given modal period for any one of the three heights is the same for both areas considered. Therefore, the most probable modal periods for both areas are the same For Sea States 5, 6, and 7 the most probable periods are about 8, 10, and 12 sec, respectively. To be consistent with the motion predictions, 7 and 9 sec are considered the most probable modal periods for Sea State 5, 9 and 11 sec for Sea State 6, and 11 and 13 sec for Sea State 7.

PREDICTED MOTIONS

All computer printouts are much too voluminous to include in this report. A copy of the results is available at DTNSRDC for future reference. Samples of computer output for the rms motions for short-crested seas are shown in Tables 6-11. The tables include ship responses of pitch, heave, roll, vertical acceleration at Station 8, where the pilothouse is to be located, and the vertical displacement and velocity at Station 15 main deck. The numbers in the body of the tables are in the form 1.6/15.0 where the first number indicates the rms value of the ship response for a 1-ft significant wave height and the second number is the modal period of the response spectra.

Significant single amplitudes of ship response can be obtained from the rms tables by multiplying the rms response by twice the significant double amplitude of wave height. A small computer program was written to calculate the significant single amplitude of all ship responses in the rms tables for any given significant wave height. Details of the program are given in Appendix A. Tables of significant responses were generated for Sea States 5, 6, and 7 with significant heights of 10.2, 16.9, and 30.6 ft (3.1, 5.1, and 9.3 m).

Limited samples of the predicted ship responses are plotted for both ships in Figures 6-11 for short-crested seas with modal periods close to those most likely to occur, as was previously discussed. These figures indicate ship response at ship headings of 0 to 180 deg in 15-deg increments for pitch, heave, roll, acceleration at Station 3 main deck, acceleration at Station 8 pilothouse, and acceleration at Station 15 main deck. The solid line is the conventional hull response and the dashed line is the LWP hull response in all figures. The sea state and modal period are given in parentheses beside each pair of curves. All responses shown are significant single amplitudes versus ship speed.

As seen in the figures, the difference in the responses of the two designs was often within the reliability of the computer predictions. Some trends are apparent, particularly in the pitch response shown in Figures 6a-6g. The pitch of the conventional hull was worse than that of the LWP hull at all headings and sea conditions, particularly at higher speeds. Another somewhat reverse trend is the roll shown in Figures 8a-8g. The roll of the conventional hull was better than the LWP hull at all but the 0- and 15-deg headings and particularly in beam saa conditions where roll was most severe. It should be noted that the roll predictions for 30 knots were not reasonable. It is suspected that roll damping used by the computer was not sufficient to simulate 30 knots. Because of the rather consistent and slowly varying nature of the roll versus speed plots, significant roll motion at 30 knots can be obtained with sufficient accuracy by extrapolation. Roll predictions from the SMSL program are not as accurate as pitch and heave predictions due to the difficulty in predicting the nonlinear roll damping moment.

In general, considering short-crested seas for any given significant wave height and heading, pitch and heave were most severe in longer period waves than the most severe roll and vertical acceleration. The wave periods to which the pitch and heave, or roll and vertical acceleration most violently responded was only different by a few seconds in short-crested seas. In long-crested seas the difference was after 6 to 10 seconds. Because of this trend, the sea condition likely to cause the most severe ship motions cannot be identified without first determining what type of ship response limits ship operation. This has been a big problem for many years and cannot be resolved

in this investigation. It should be noted that if extreme vertical accelerations or roll limit the operation of the ship, then oceans where waves are generally short should be avoided. If extreme pitch or heave limit the ship operation, then larger oceans where wave swells are common should be avoided. Wave swells are generally long-crested, with long wave period. This is true for both the conventional and LWP ship since both have similar motions.

To explore what is being missed by considering only the most probable modal period, Figures 12 and 13 were prepared to show pitch, heave, and roll motions and vertical acceleration at Station 3 for a heading and wave mc al period where responses were nearly maximum. The pitch and heave motions shown in Figure 12 indicate that seas with 15-, 17-, and 21-sec modal periods were most severe. The probability of encountering seas with significant heights of 10 2 ft and modal period of 21 sec is small but they do occur. The roll motion shown in Figure 13 indicates that seas with 11- and 13-sec modal periods cause the most severe roll. As indicated before, seas with shorter waves caused the most severe accelerations, as seen in Figure 13.

In general, the difference between the motions shown in Figures 12 and 13 and those shown previously for the most probable wave period was only about 1 or 2 percent except for heave. The heave shown in Figure 12 was about 10 percent greater than that shown for the most porobable modal period.

DECK WETNESS, BOW EMERGENCE, AND SLAMMING

Motion of the bow relative to the water surface, i.e., relative bow motion, was computed at ship Stations 0, 0.5, 1.0, and 3.0 for long-crested head seas and the results are stored on a disk pack. A small program, explained in Appendix B, was developed to access the stored relative bow motion and compute the number of occurrences of slamming, bow emergence, and deck wetness.

Figure 14 shows the number of times per hour that the deck was wet for both ships. Bretschneider sea spectra with significant heights of 23.5 and 30.6 ft (7 2 and 9.3 m) and a modal period of 13 sec were used in the calculations. The deck was considered to be wet when the wave surface at the forward perpendicular ship freeboard of 34.80 ft (10.61 m) for the conventional and 35.10 ft (10.70 m) for the LWP hull.

As seen in the figure, the difference in the deck wetness characteristic of the two hulls is small, with the LWP hull having slightly less deck wetness at speeds above 15 knots.

Figure 15 shows the number of sonar dome window emergence per hour for both hulls in Sea States 6, low 7, and 7 with significant wave heights of 16.9, 23.5, and 30.6 ft (5.1, 7.2, and 9.3 m) and modal periods of 11, 13, and 13 sec, respectively. The sonar window was considered to be located at Station 0.5 and respectively 22.15 and 22.50 ft (6.75 and 6.86 m) below the waterline for the conventional and LWP hull forms. Again, the LWP hull had slightly fewer window emergences per hour than the conventional hull, particularly at speeds above 10 knots.

Figure 16 shows the number of slams per hour at Station 3 for both hulls in Sea States 6, low 7, and 7. The draft at Station 3 used in the slamming calculations was 22.15 ft (6.75 m) for the conventional hull and 22.50 ft (6.86 m) for the LWP hull. The difference between the slamming characteristics of the two hulls was negligible.

In general, the relative motion and thus the deck wetness, sonar window emergence, and slamming characteristics of the two hull forms were very similar. Both ships responded most severely in deck wetness, etc., to long waves and swell conditions.

CONCLUSIONS

The ship motion, velocity, and acceleration responses as well as deck wetness, sonar dome window emergence, and slamming characteristics have been predicted for two proposed CSGN hull designs. It was found that the ship responses were very similar for the two hulls. The LWP hull did appear to be slightly better than the conventional hull in most comparisons. However, the conventional hull was better in roll than the LWP. There is no significant evidence to support one hull form over the other.

The pitch and heave motions of both designs were most severe in longer waves and swells; however, the roll and vertical accelerations were most severe in seas with shorter waves.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to Ms. Susan Bales and Mr. Nathan Bales for their efforts in the administration of this project. Thanks are also due to Mr. William Meyers for his technical assistance, and to Mr. Everett Woo for his assistance in preparing this report.

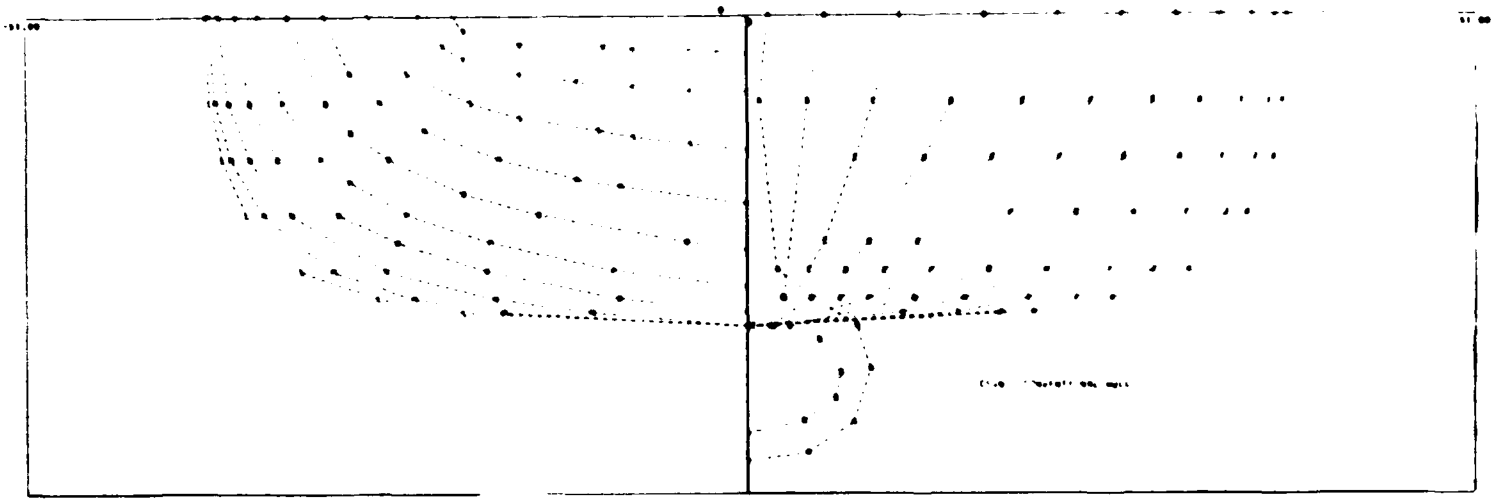

Figure 1 - Body Plan of Conventional Hull, C17.2

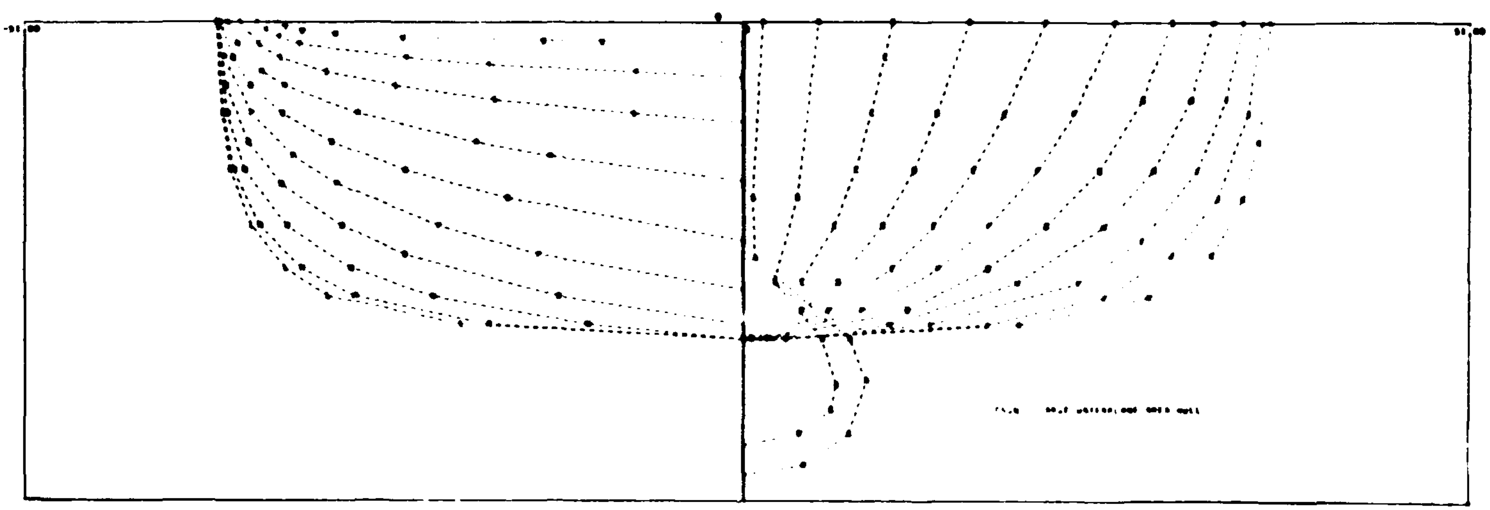

Figure 2 - Body Plan of Large Waterplane Hull, C24.2

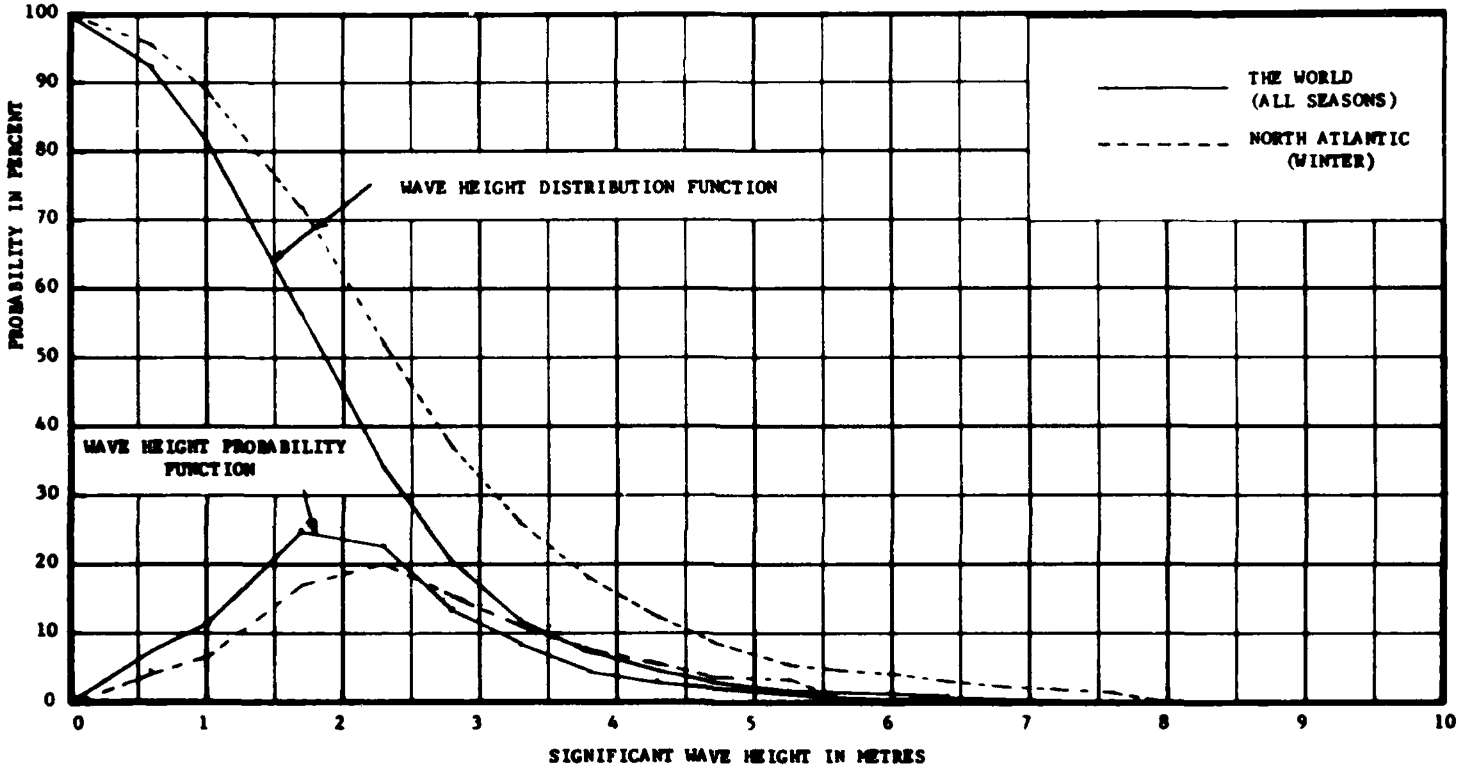

Figure 3 - Worldwide All Season and Winter North Atlantic Wave Probability and Distribution Functions

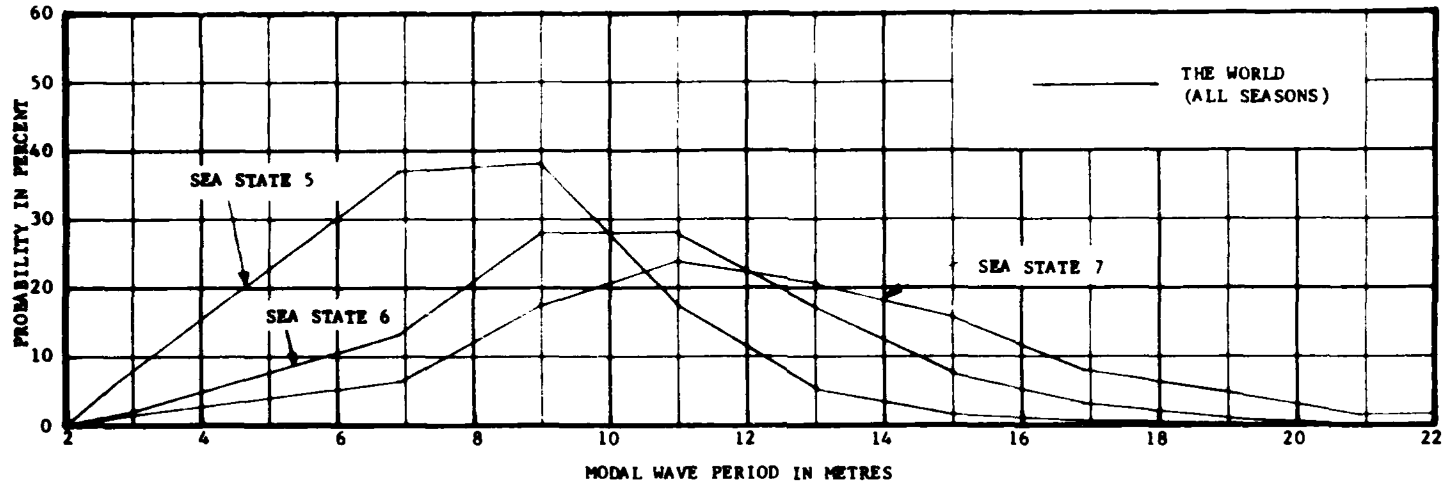

Figure 4 - Sea Spectra Modal Period Distribution for Sea States 5, 6, and 7 All Over the World

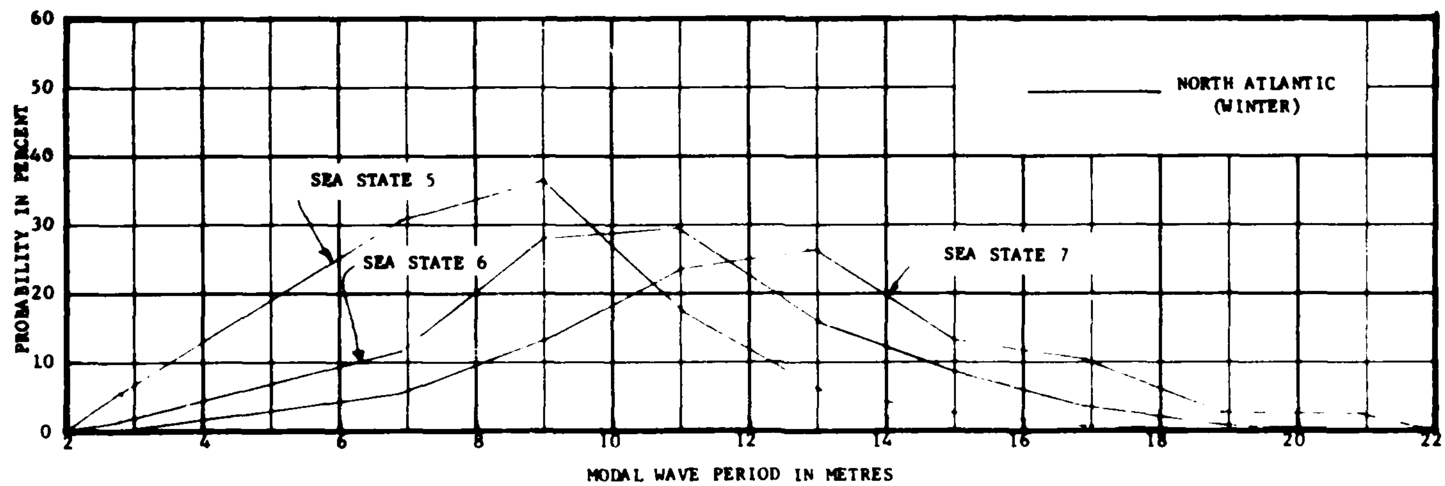

Figure 5 - Sea Spectra Modal Period Distribution for Sea States 5, 6, and 7 in the Winter North Atlantic

Figure 6 - Significant Pitch for Various Headings

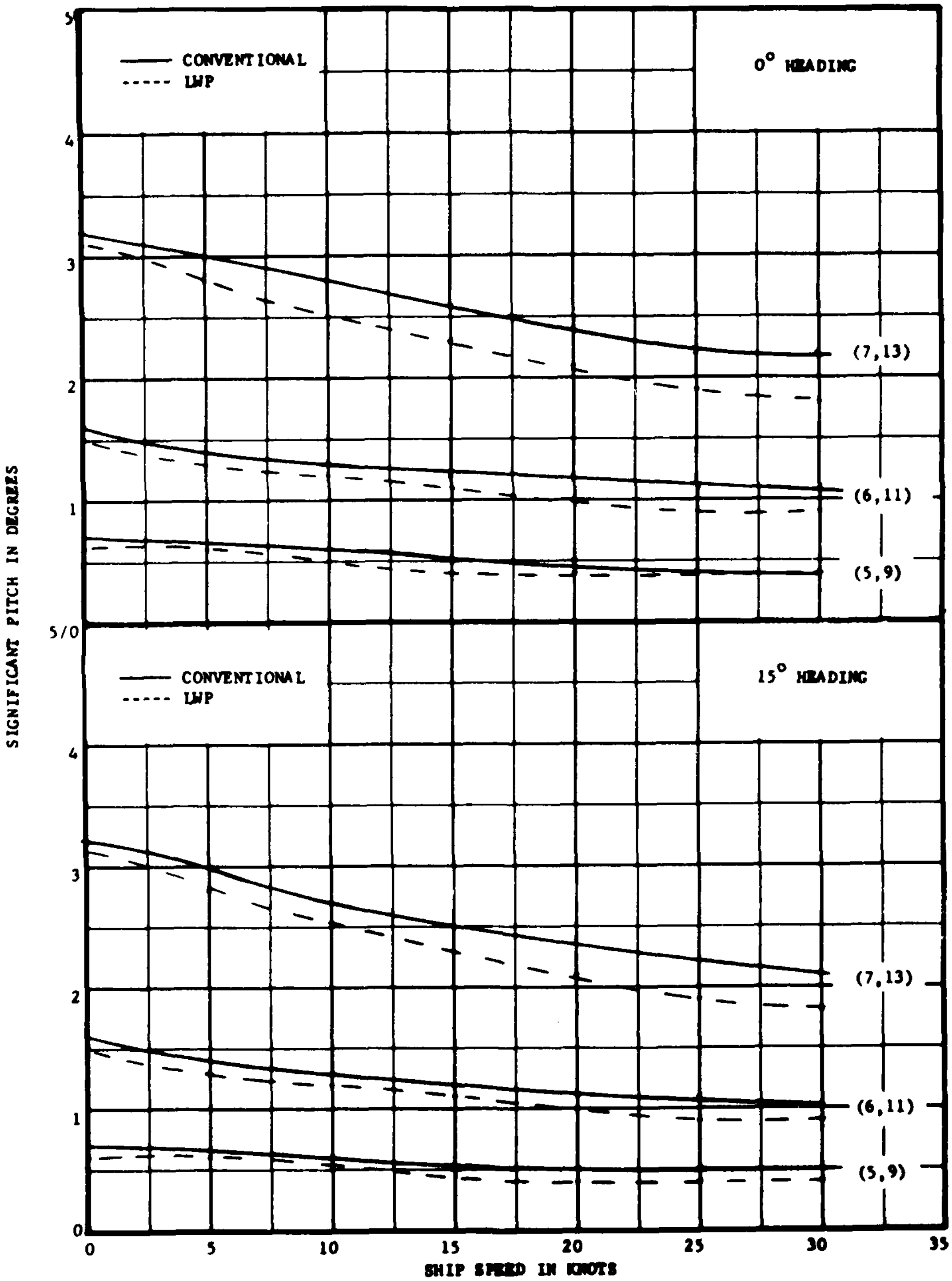

Figure 6a - For 0- and 15-Degree Headings

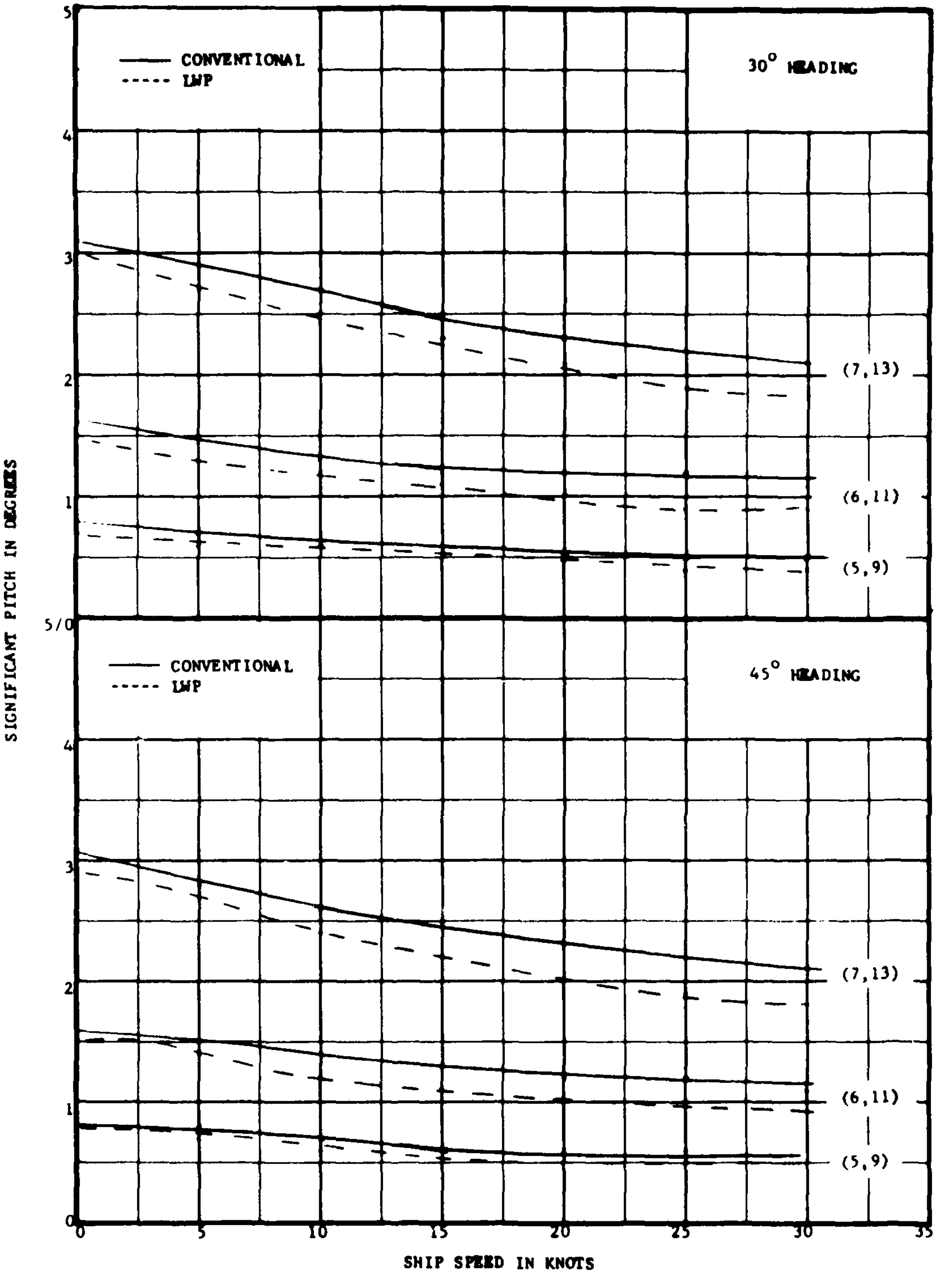

Figure 6b - For 30- and 45-Degree Headings

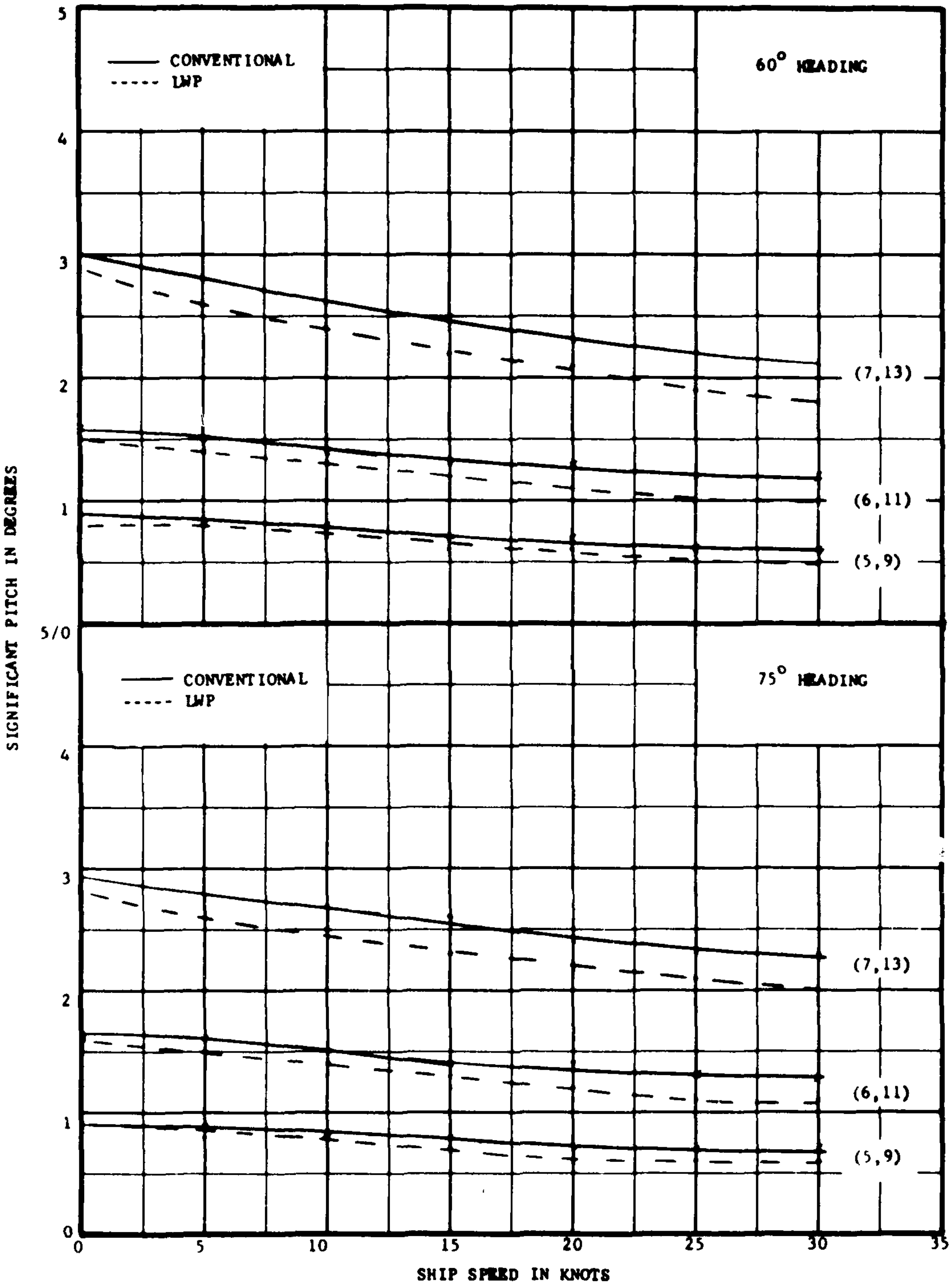

Figure 6c - For 60- and 75-Degree Headings

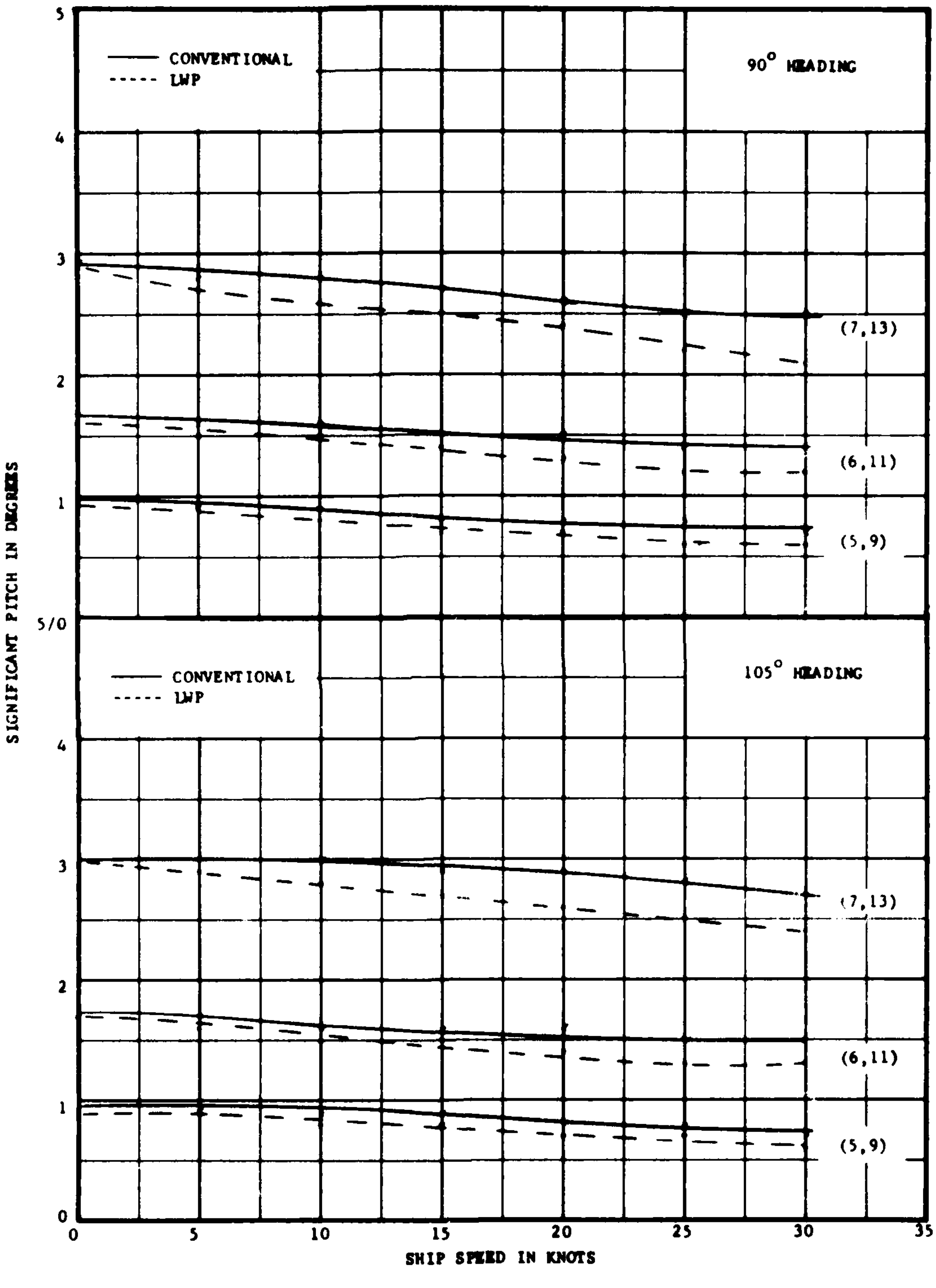

Figure 6d - For 90- and 105-Degree Headings

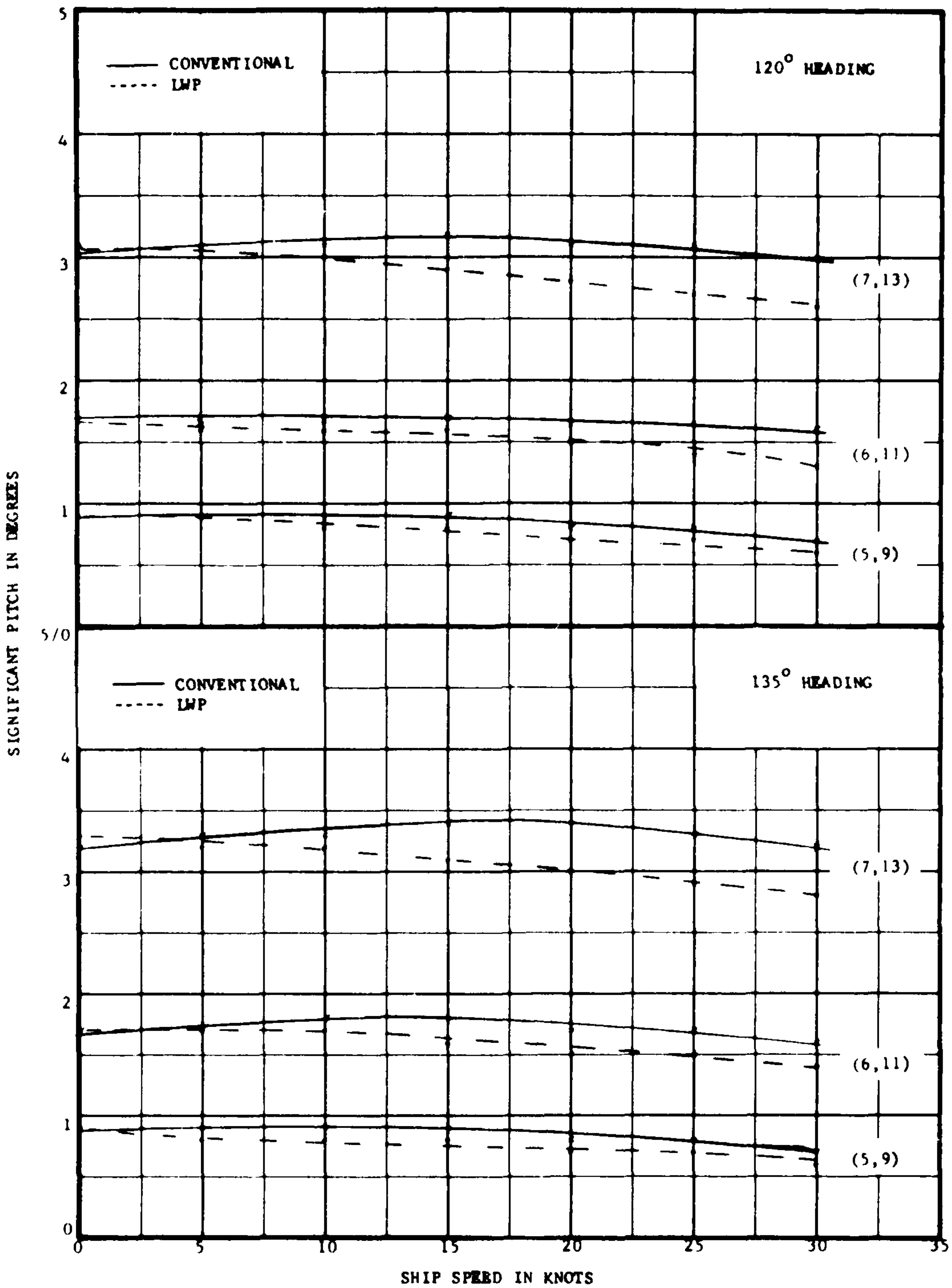

Figure 6e - For 120- and 135-Degree Headings

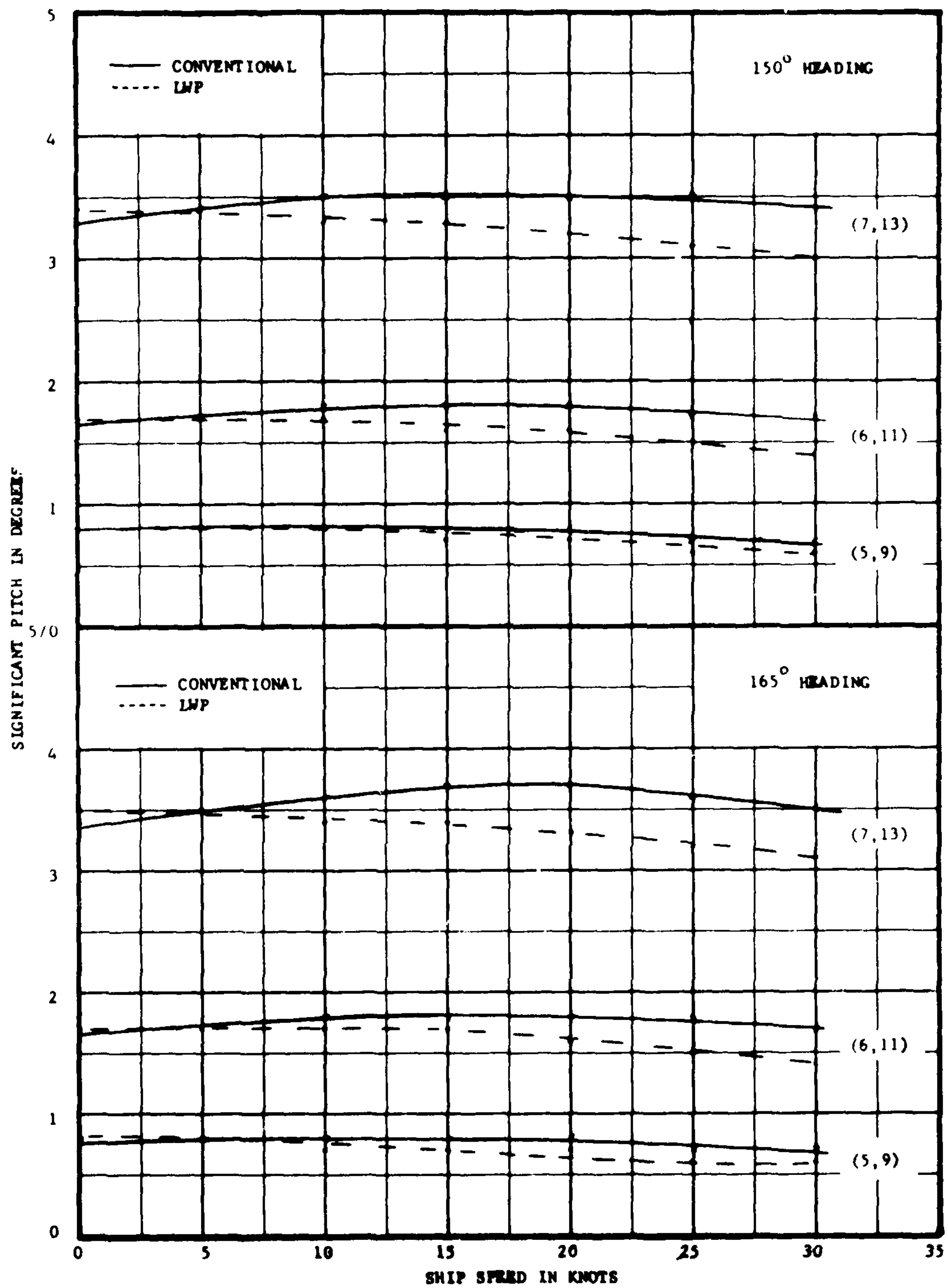

Figure 6f - For 150- and 165-Degree Headings

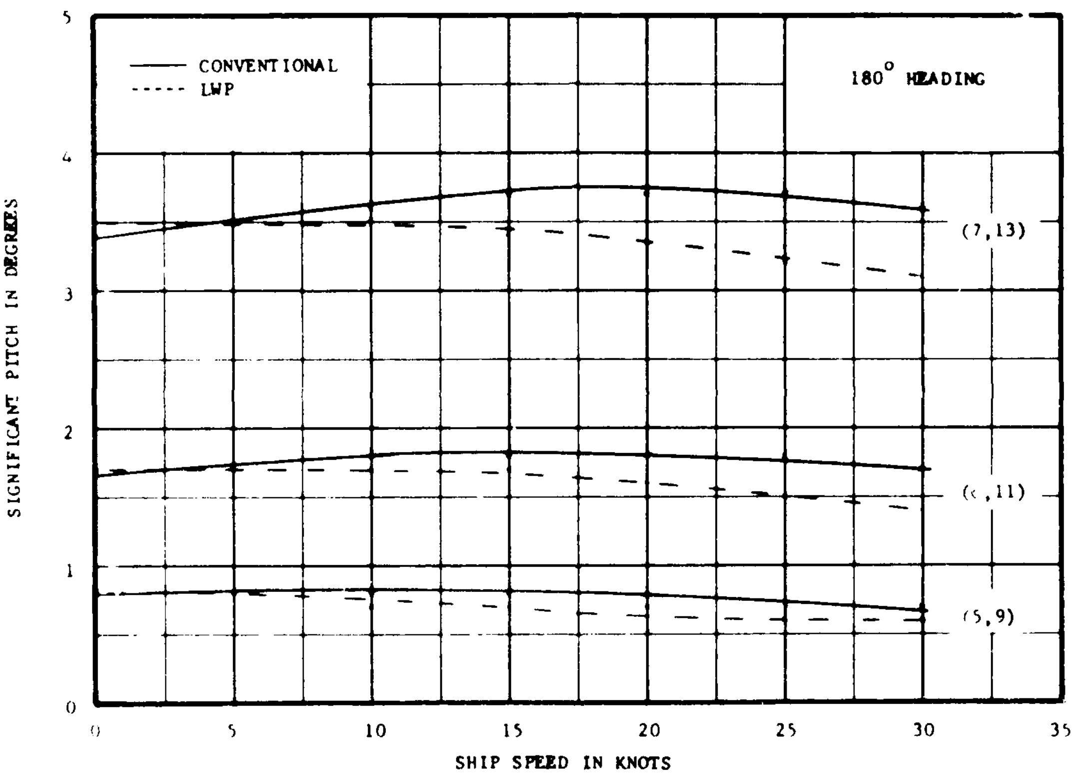

Figure 6g - For 180-Degree Heading

Figure 7 - Significant Heave for Various Headings

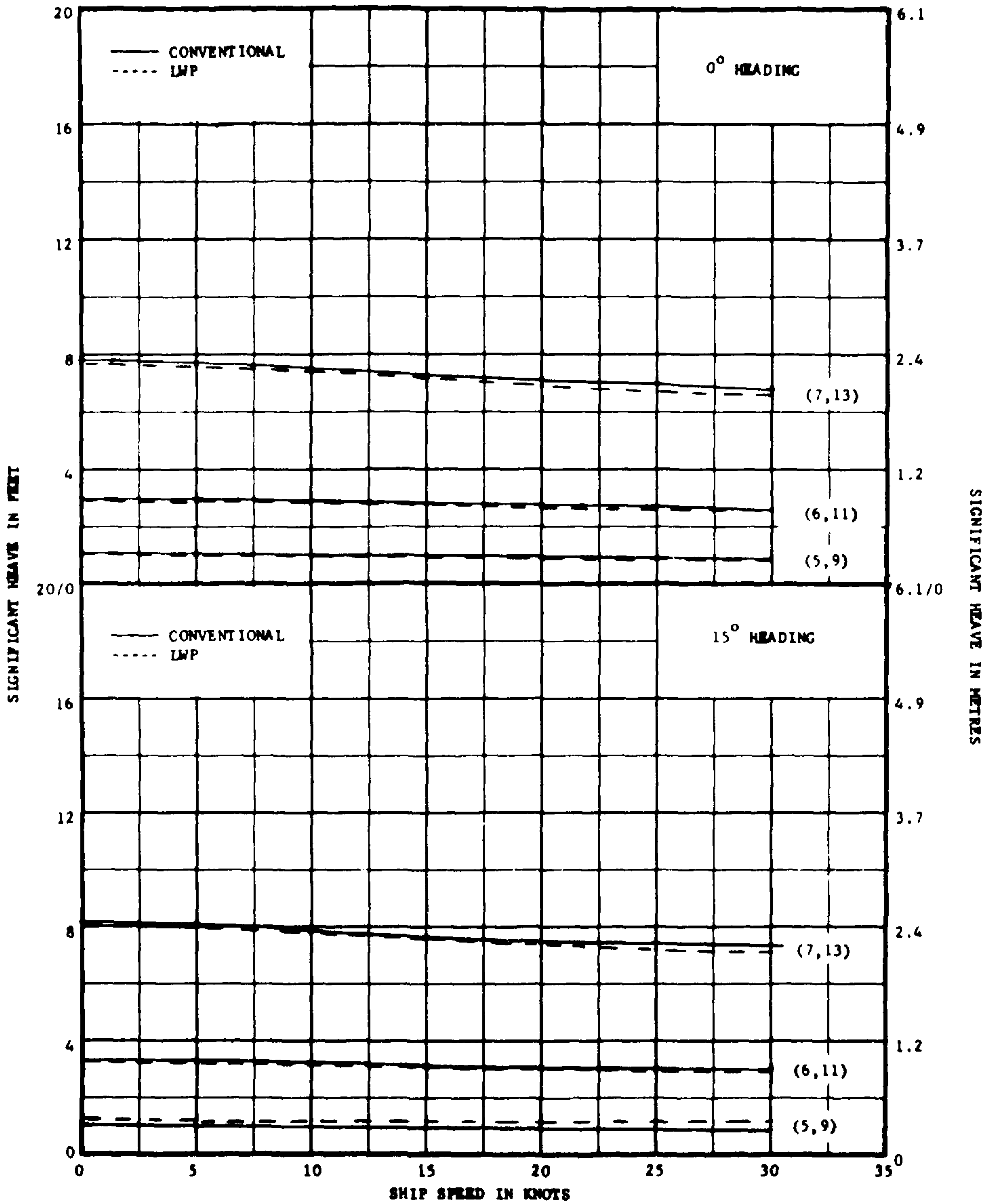

Figure 7a - For 0- and 15-Degree Headings

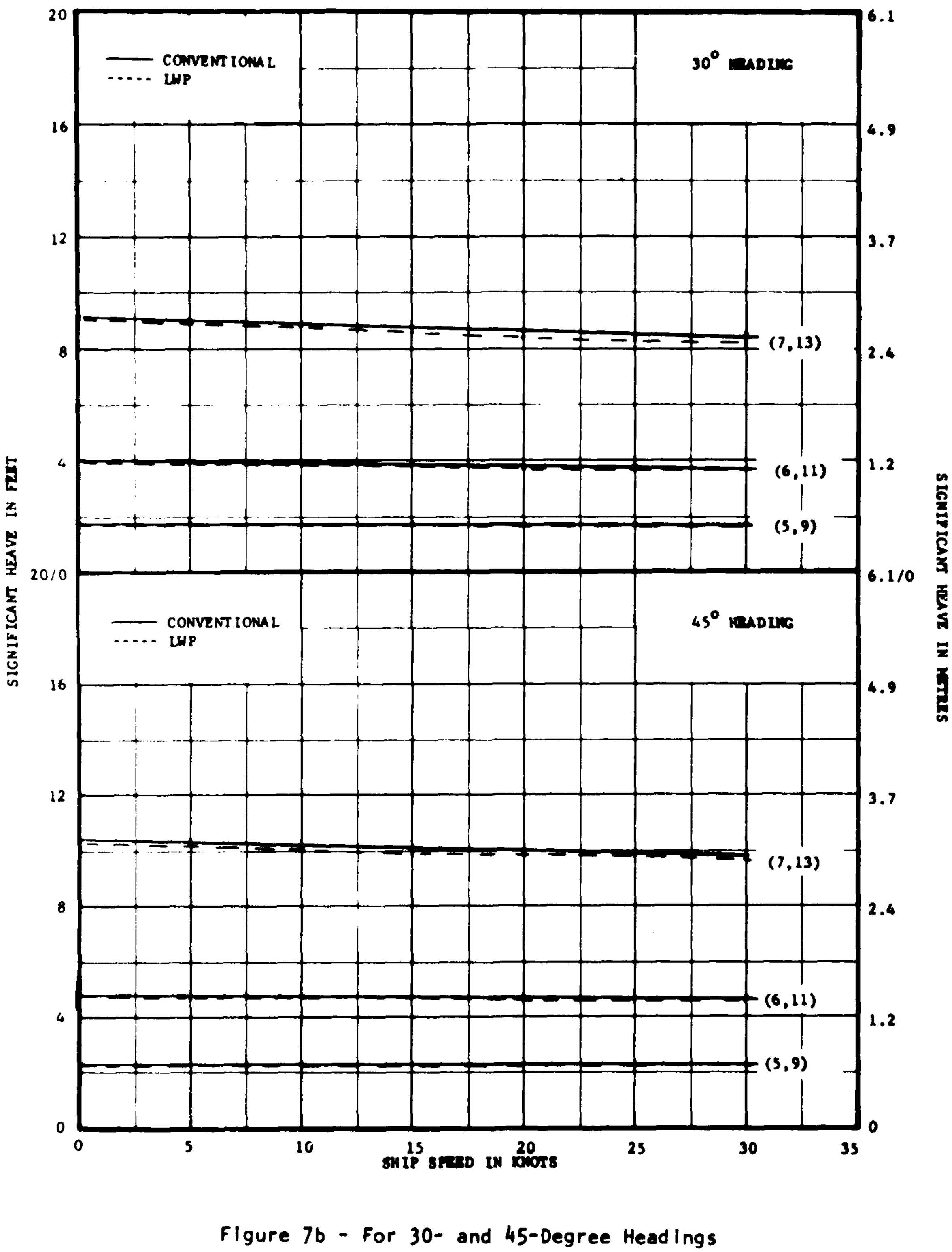

Figure 7b - For 30- and 45-Degree Headings

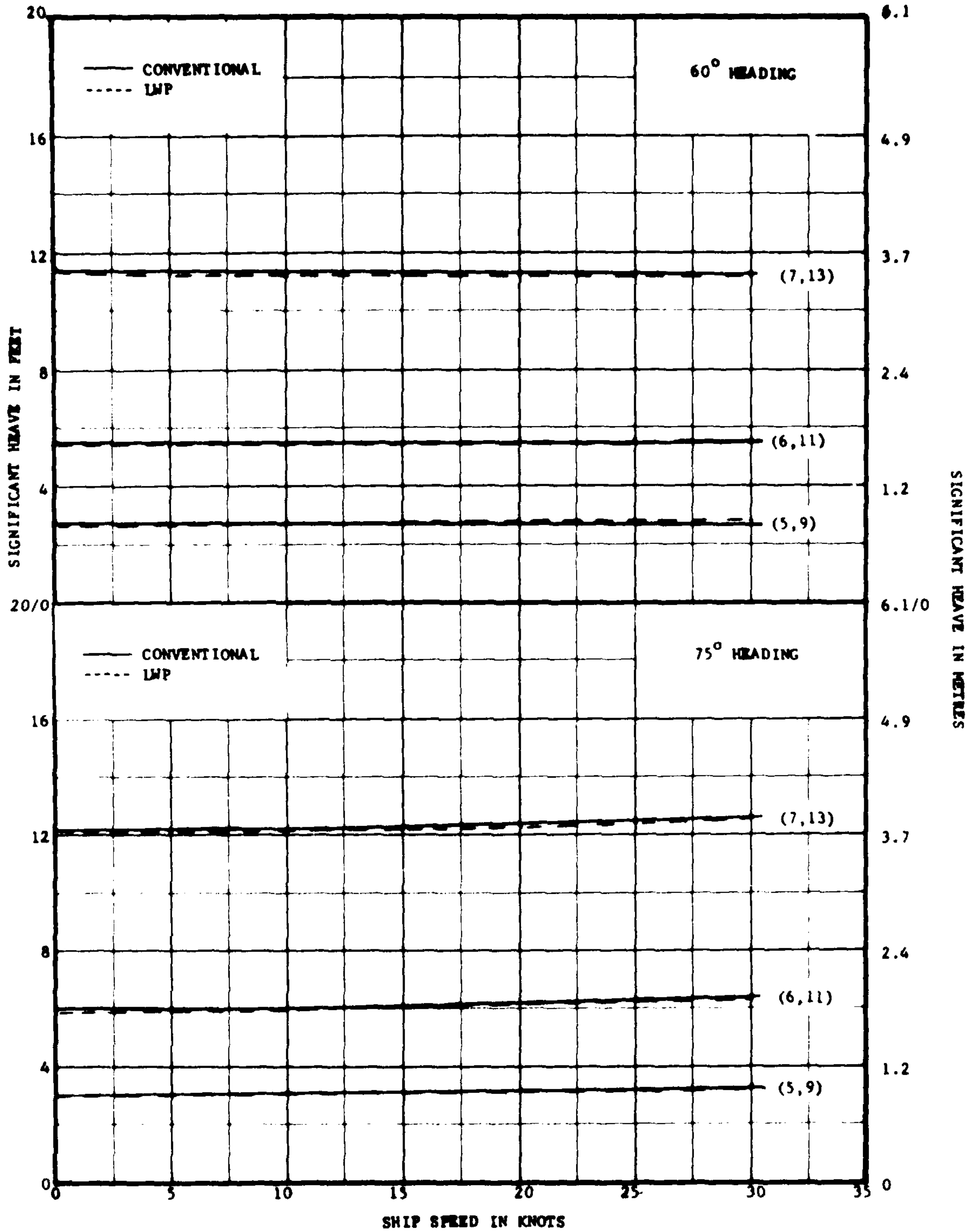

Figure 7c - For 60- and 75-Degree Headings

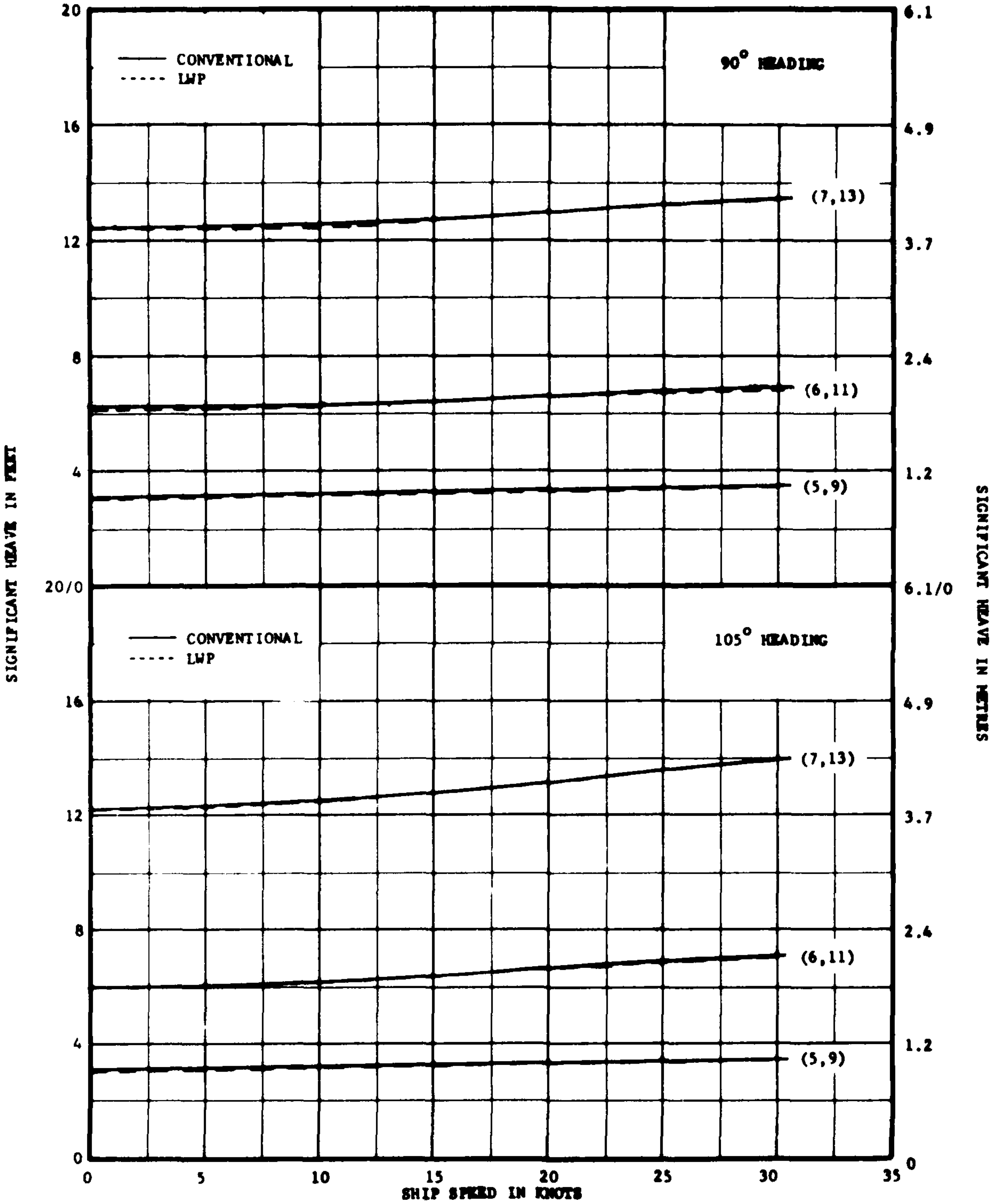

Figure 7d - For 90- and 105-Degree Headings

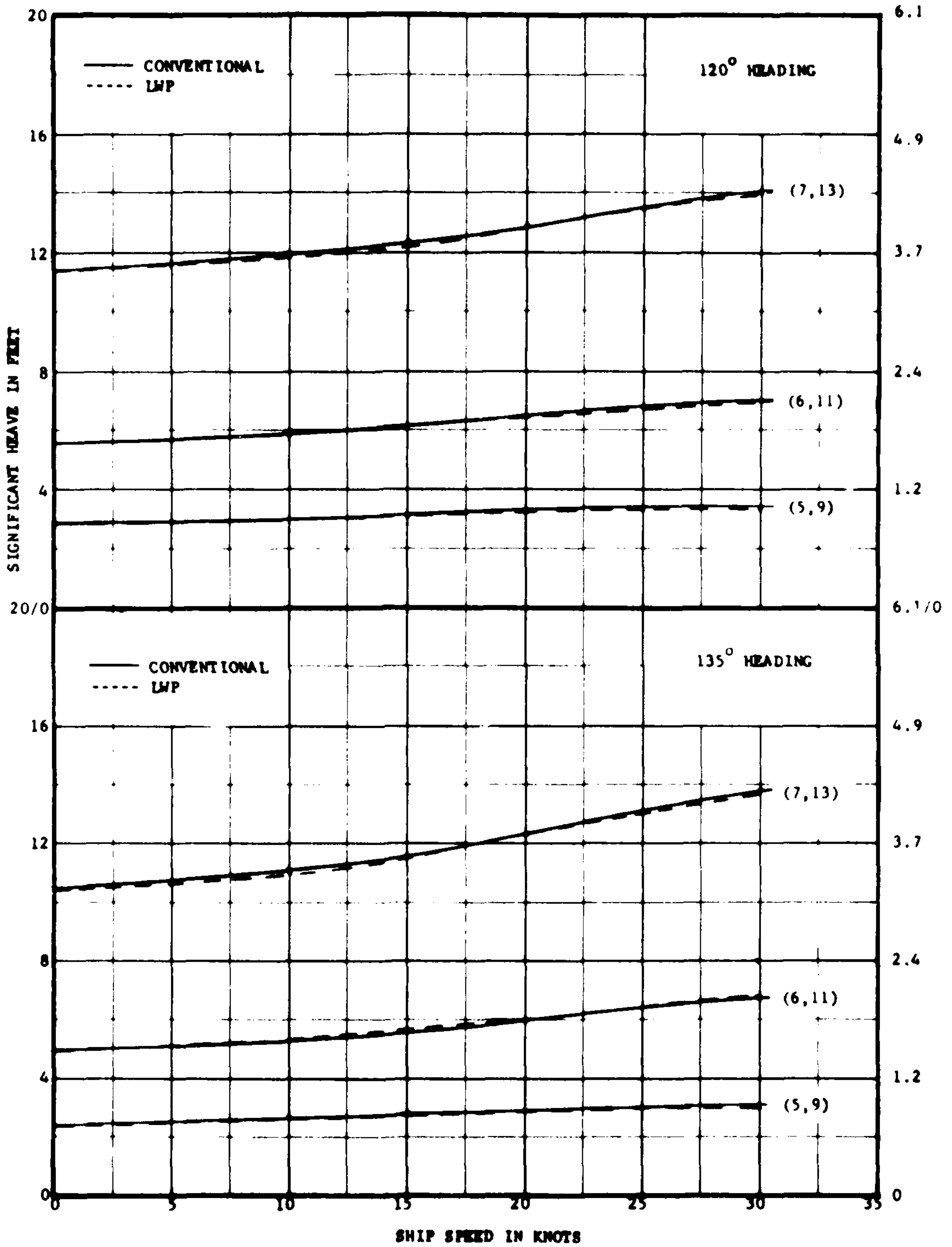

Figure 7e - For 120- and 135-Degree Headings

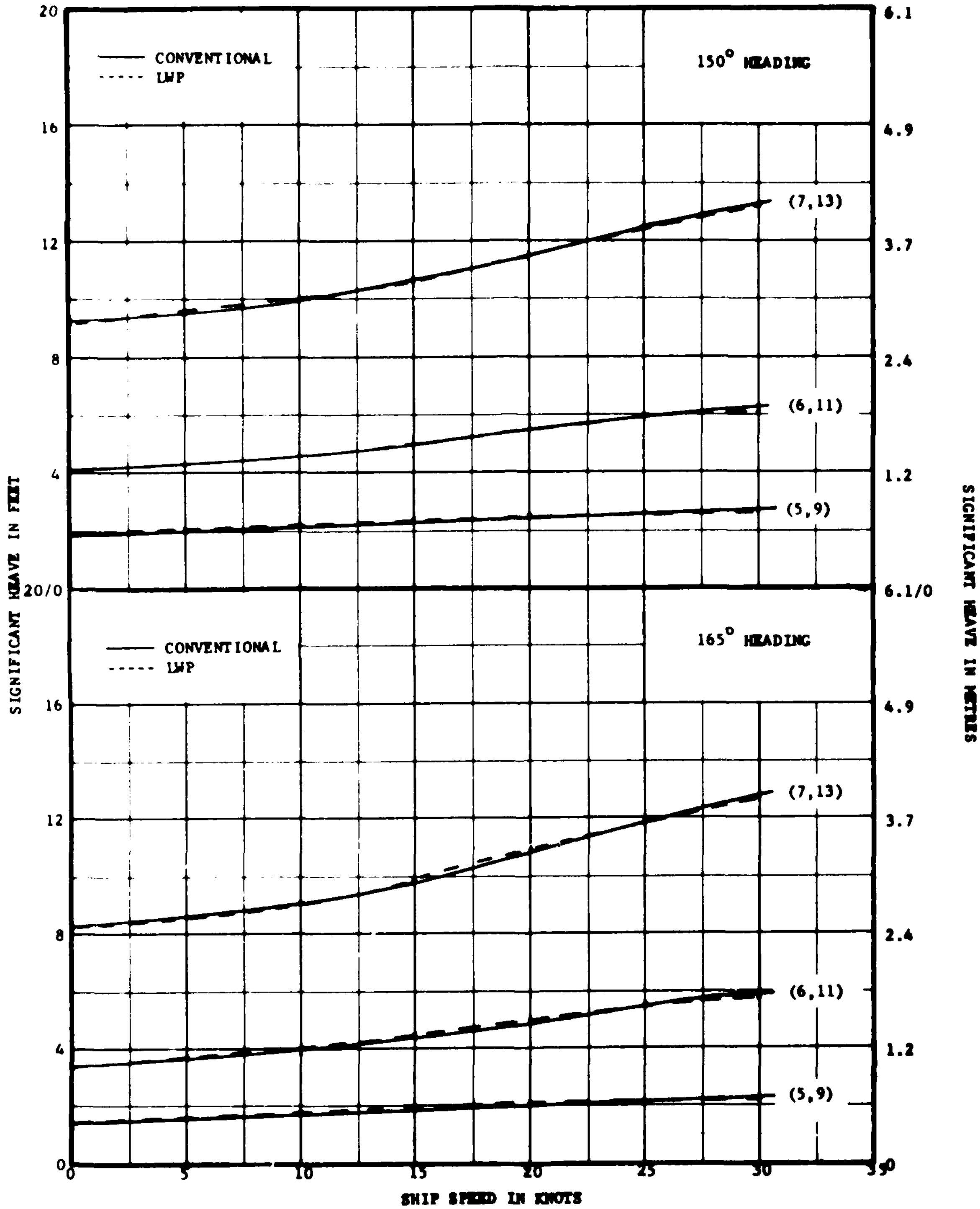

Figure 7f - For 150- and 165-Degree Headings

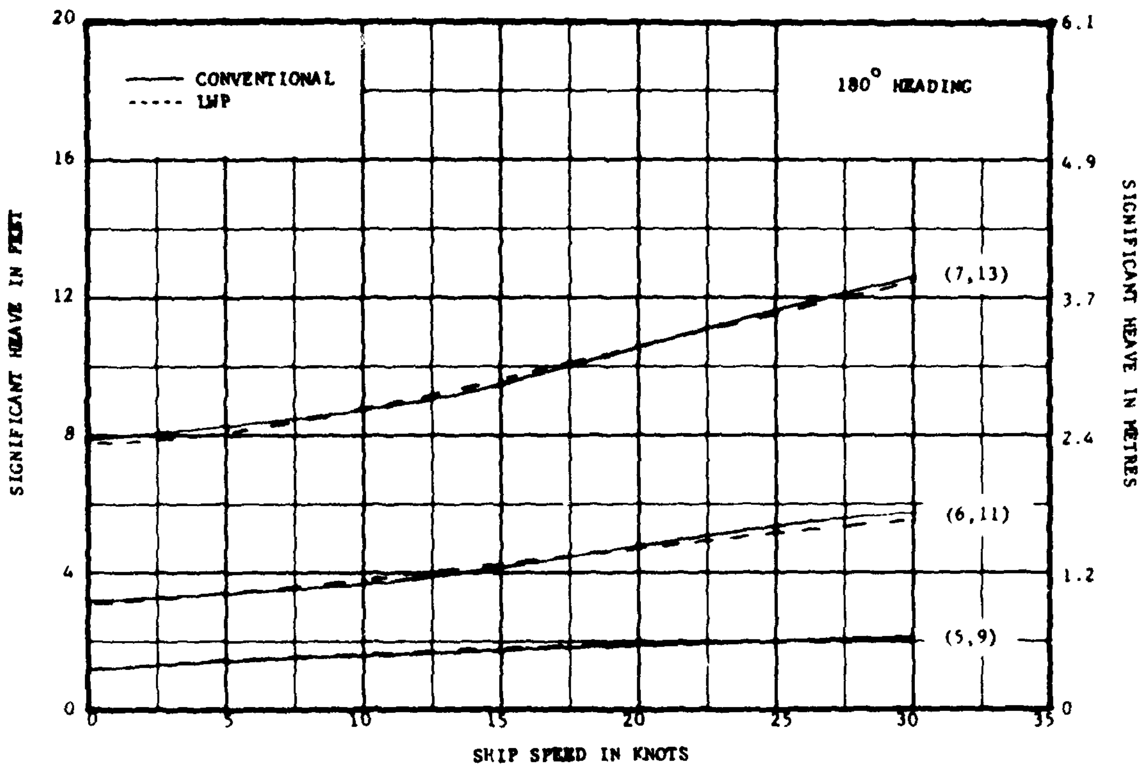

Figure 7g - For 180-Degree Heading

Figure 8 - Significant Roll for Various Headings

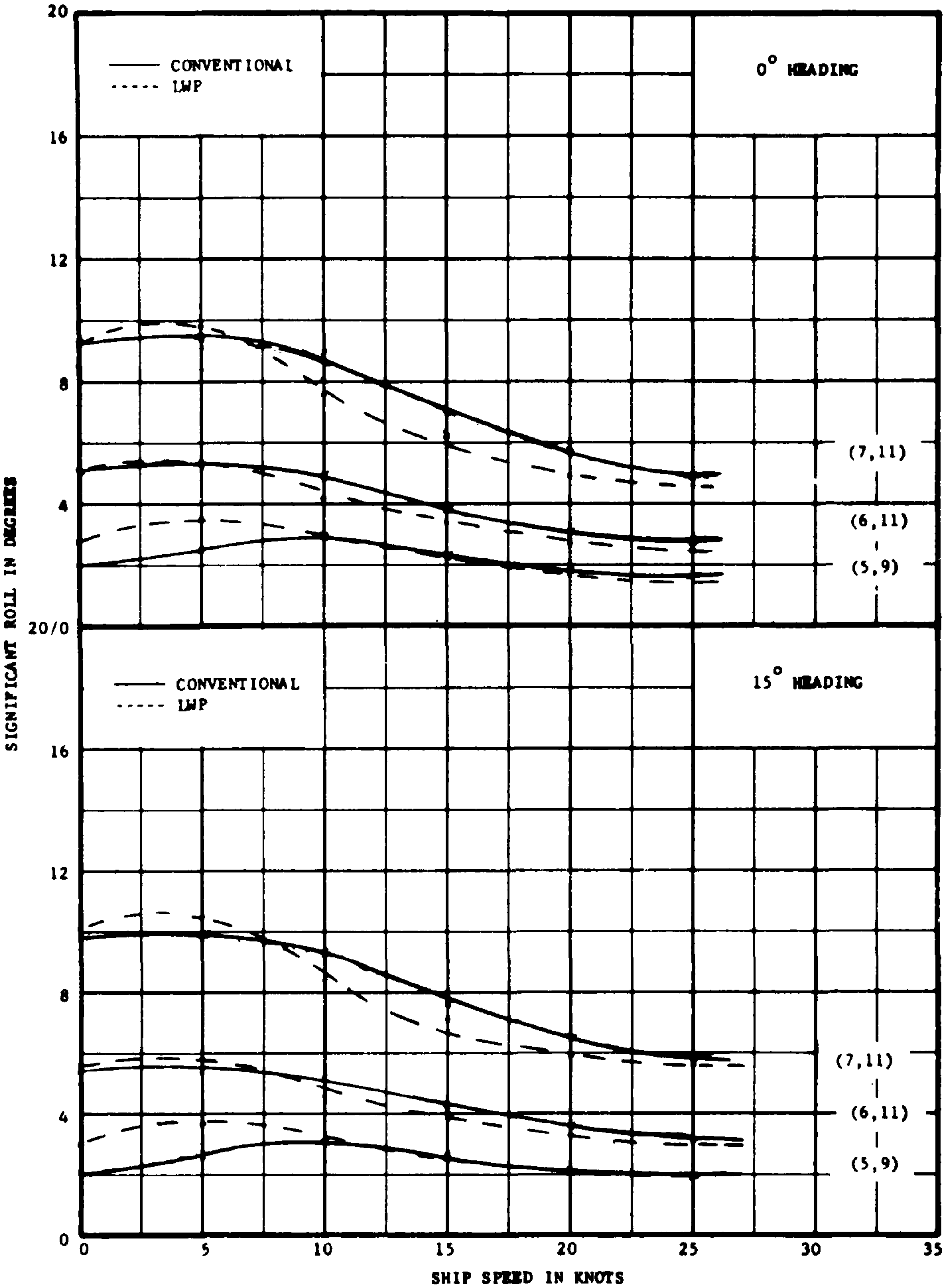

Figure 8a - For 0- and 15-Degree Headings

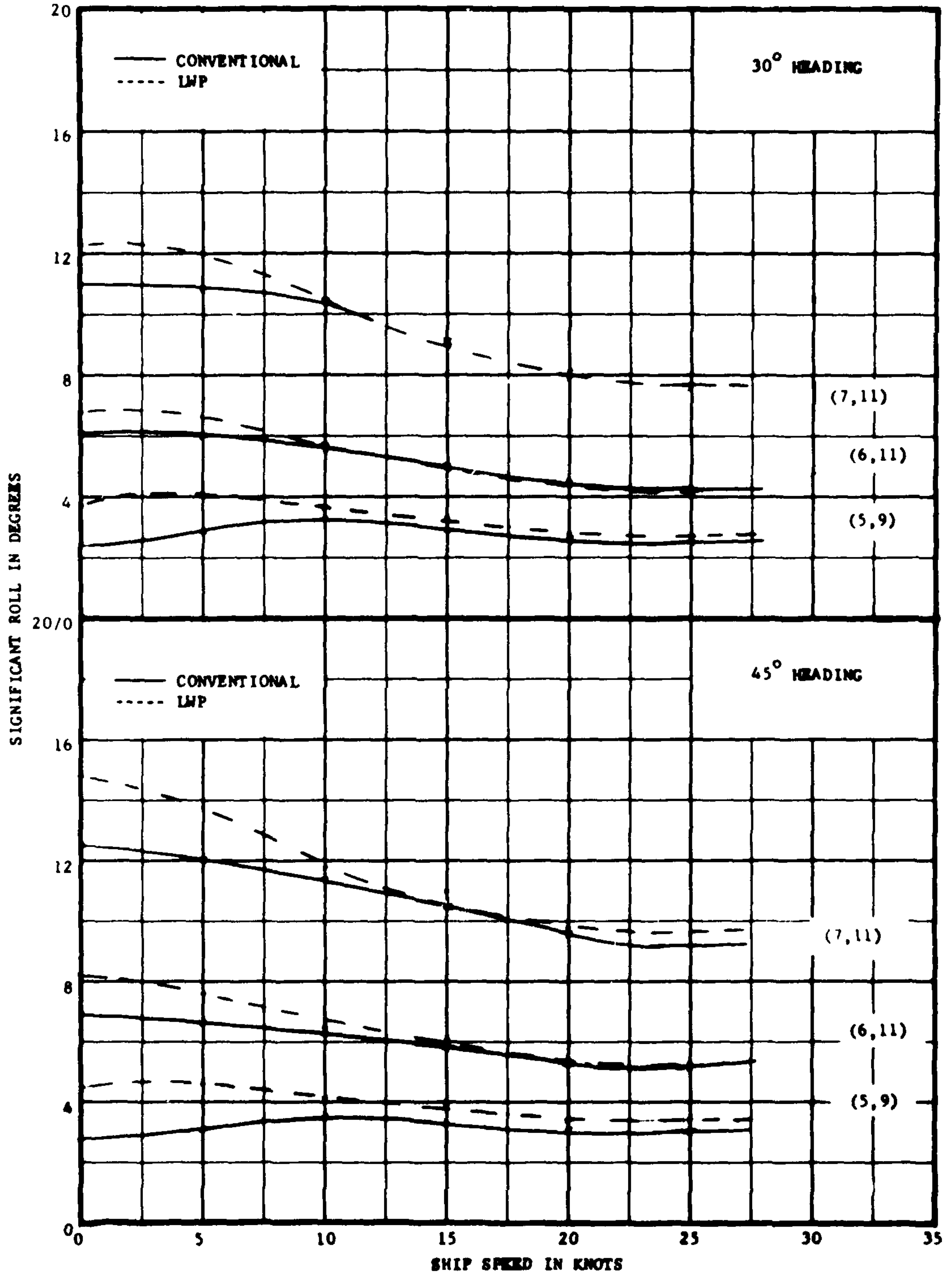

Figure 8b - For 30- and 45-Degree Headings

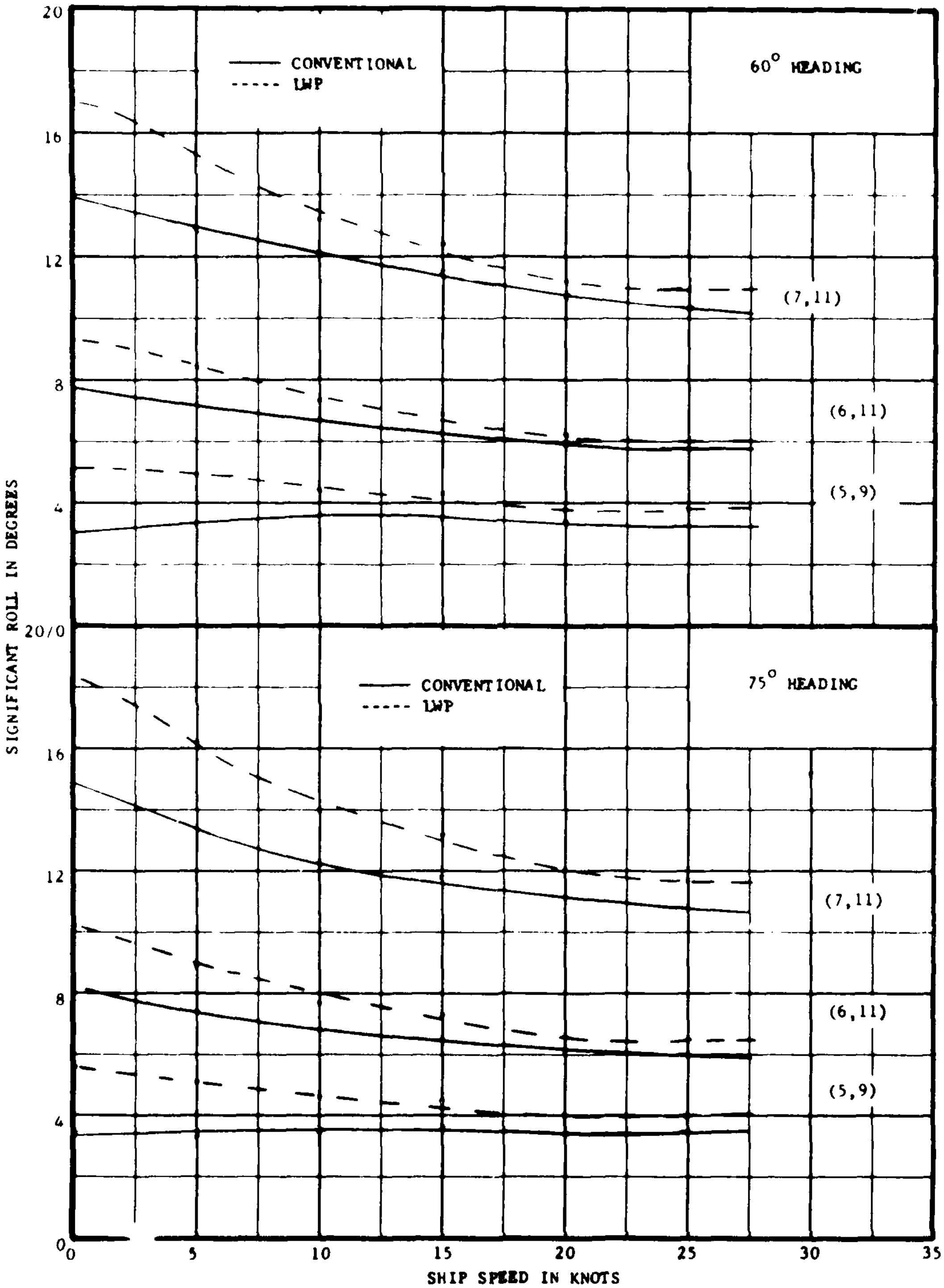

Figure 8c - For 60- and 75-Degree Headings

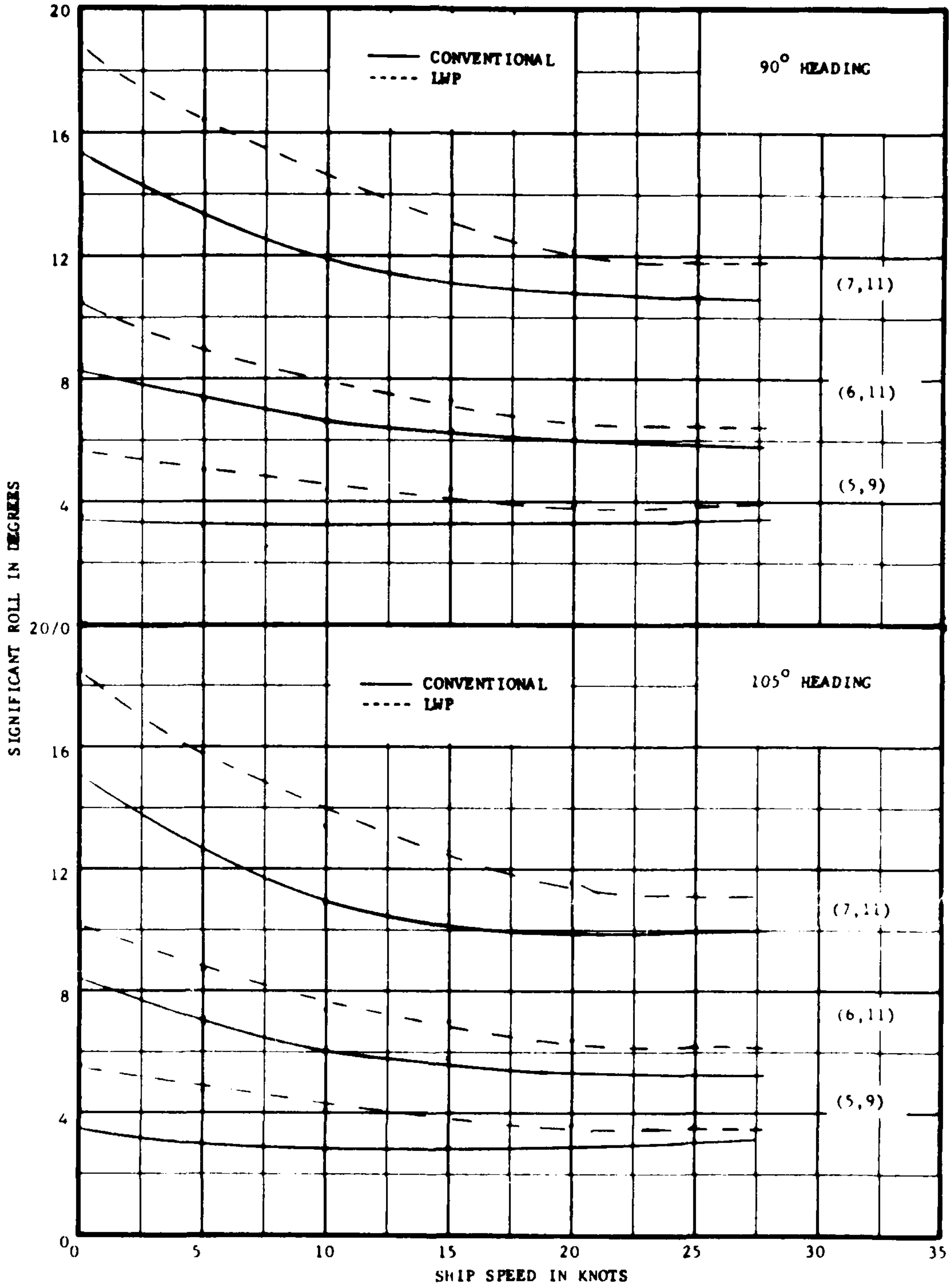

Figure 8d - For 90- and 105-Degree Headings

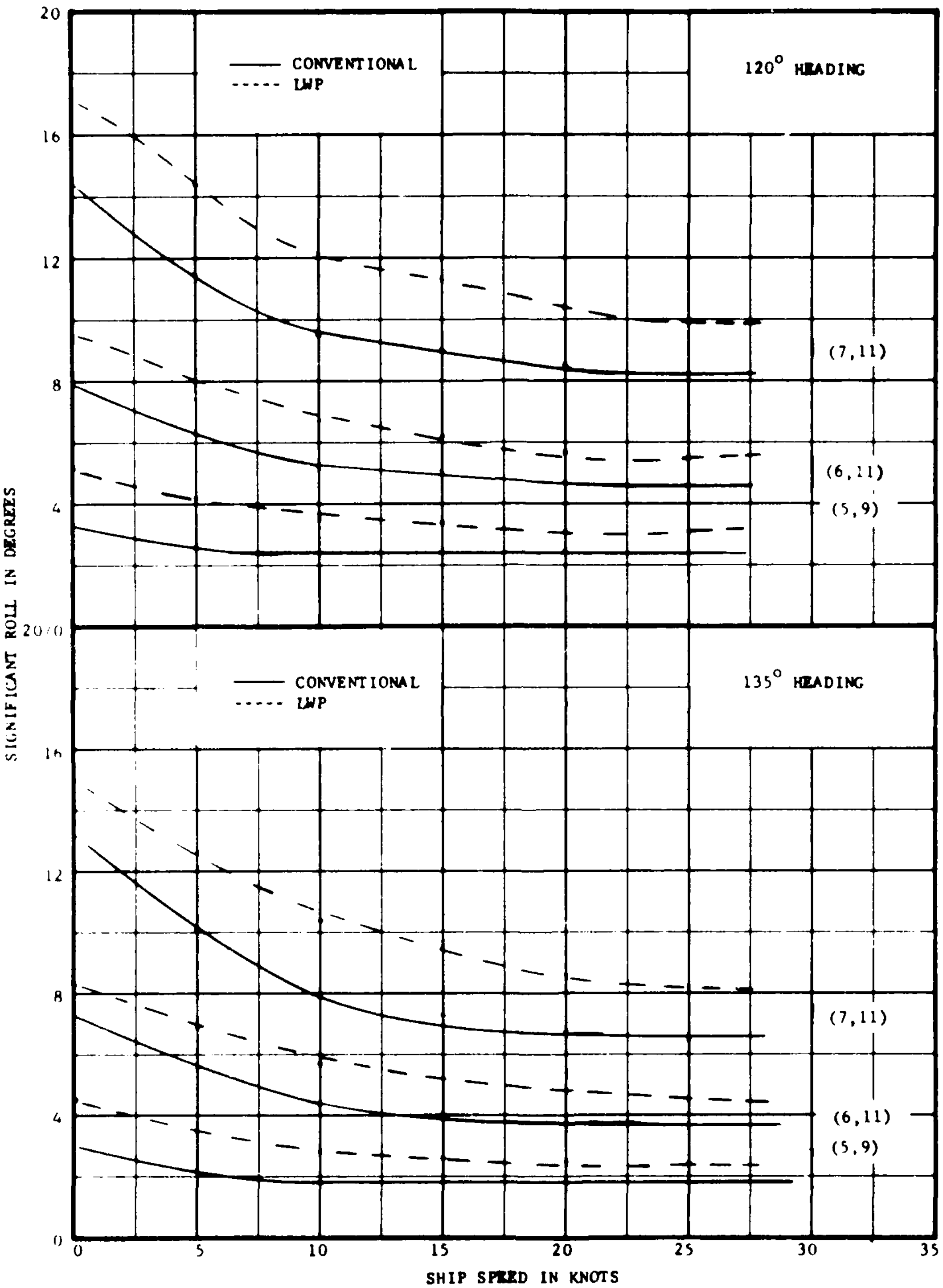

Figure 8e - For 120- and 135-Degree Headings

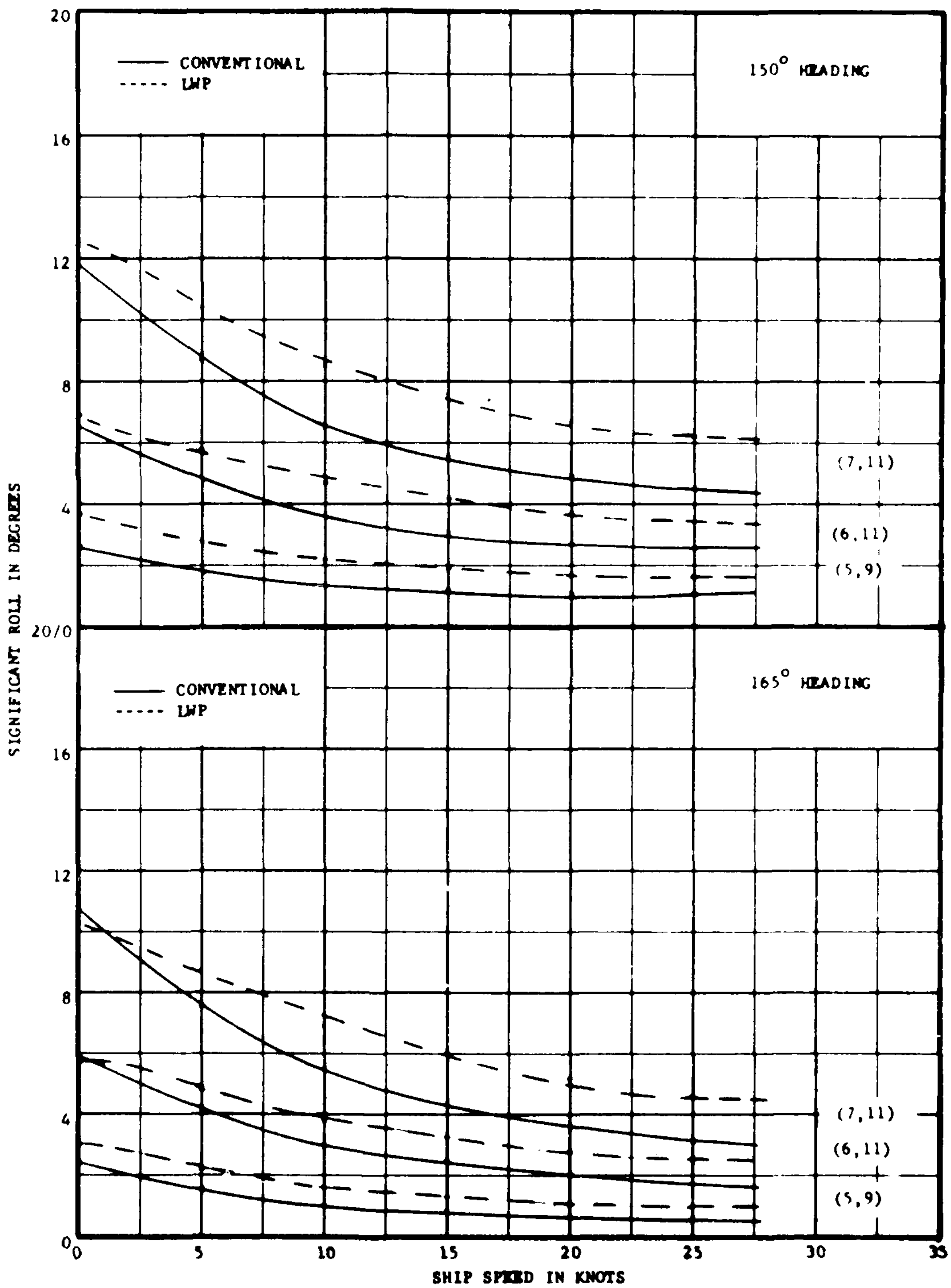

Figure 8f - For 150- and 165-Degree Headings

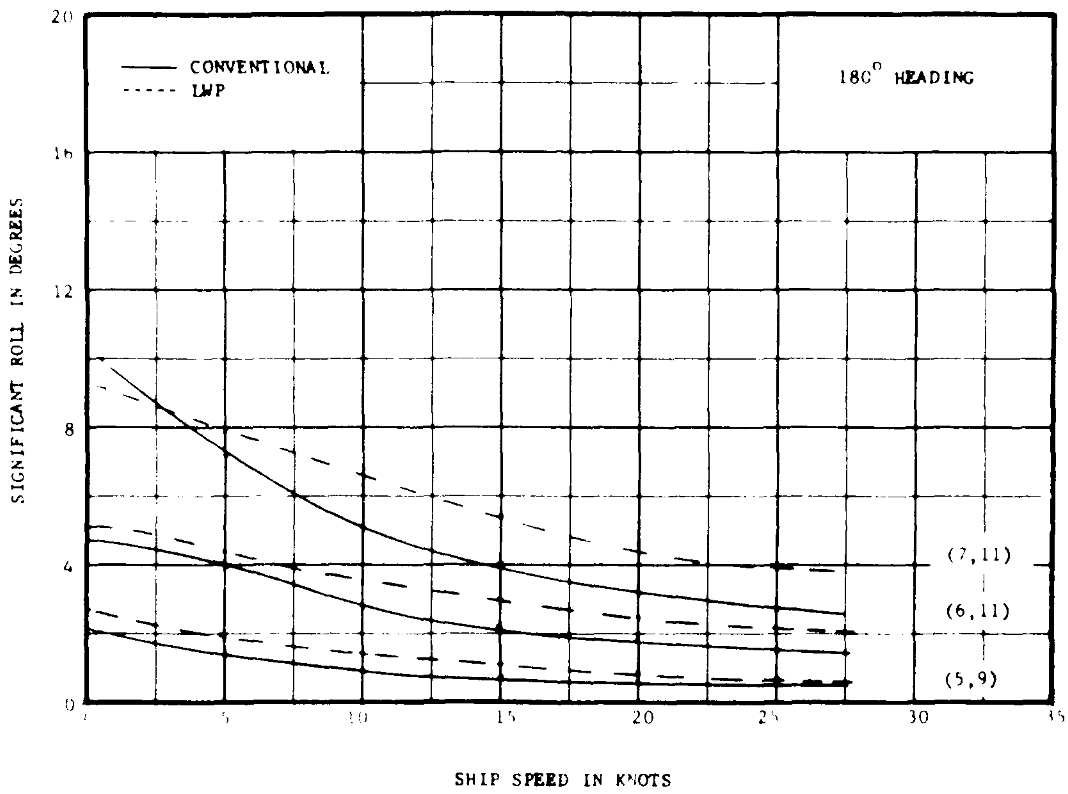

Figure 8g - For 180-Degree Heading

Figure 9 - Significant Acceleration at Station 3 for Various Headings

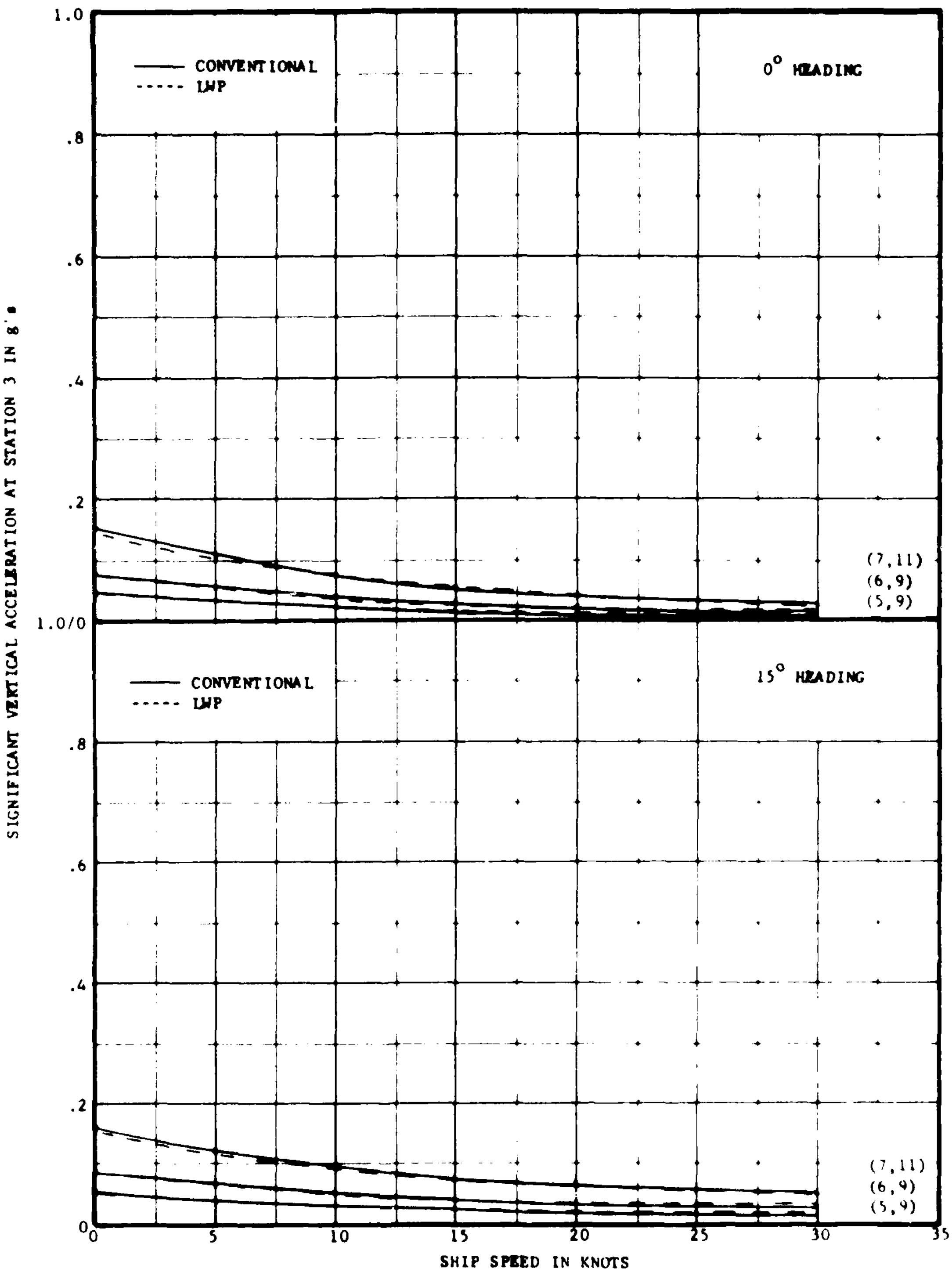

Figure 9a - For 0- and 15-Degree Headings

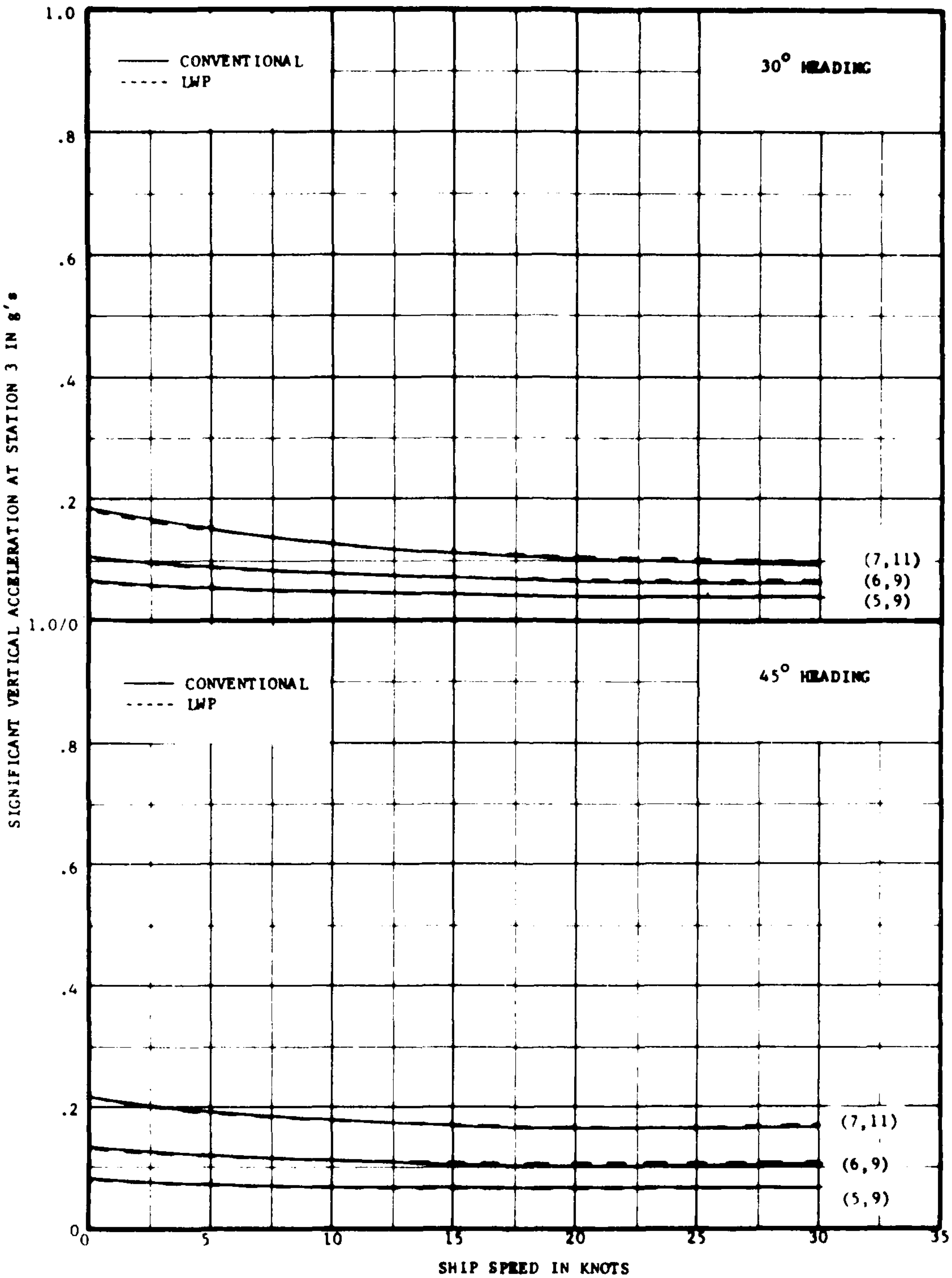

Figure 9b - For 30- and 45-Degree Headings

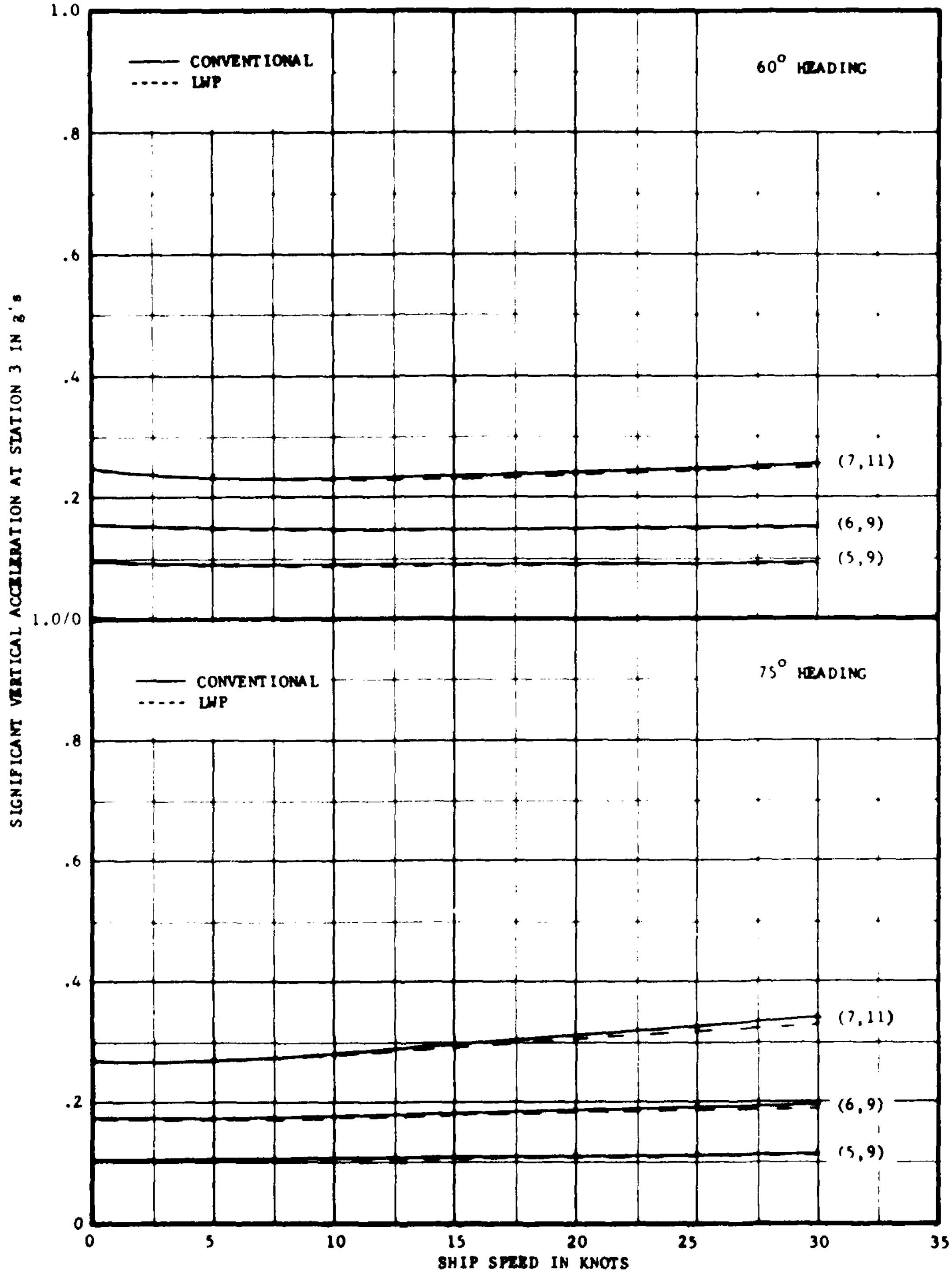

Figure 9c - For 60- and 75-Degree Headings

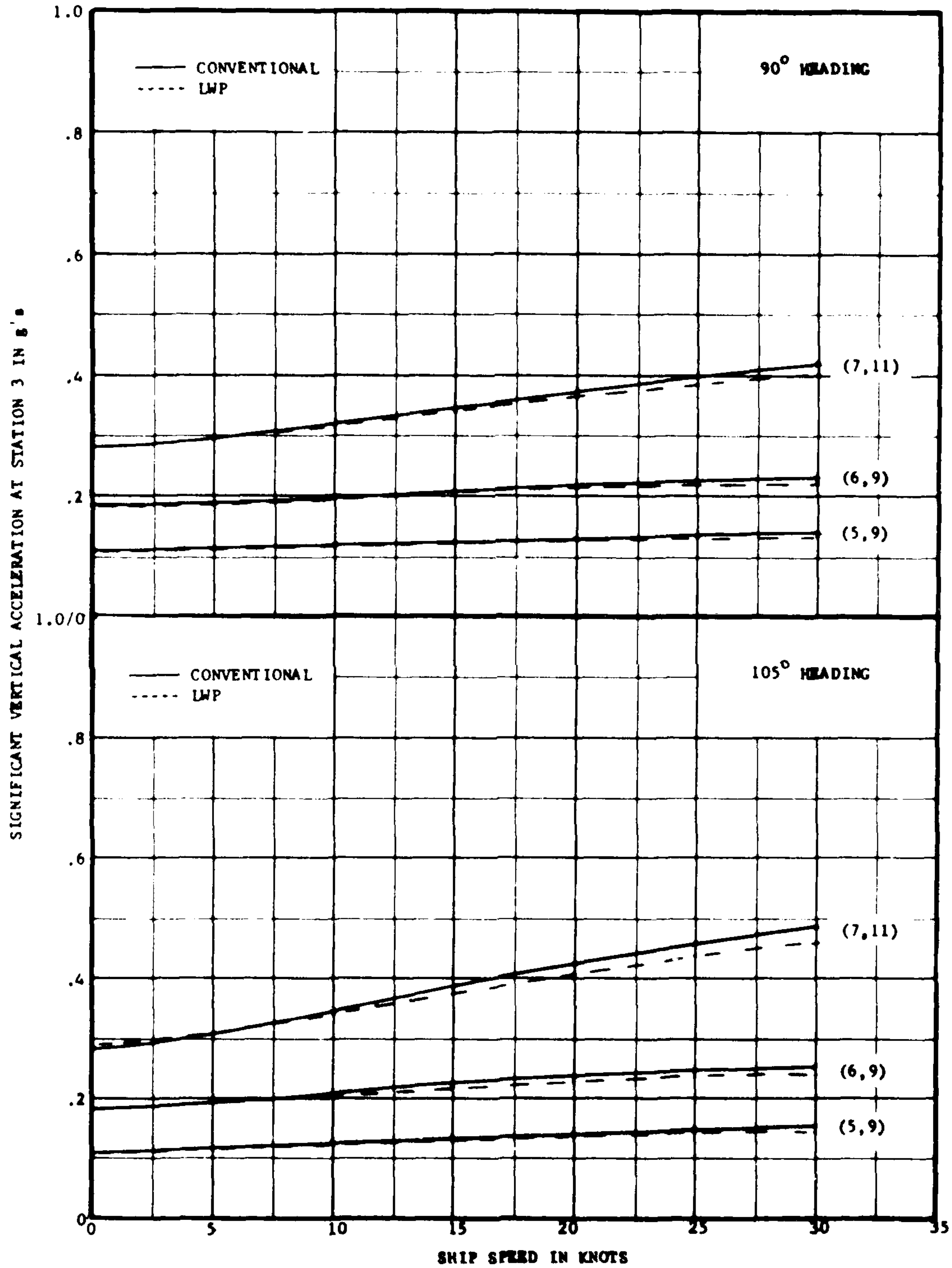

Figure 9d - For 90- and 105-Degree Headings

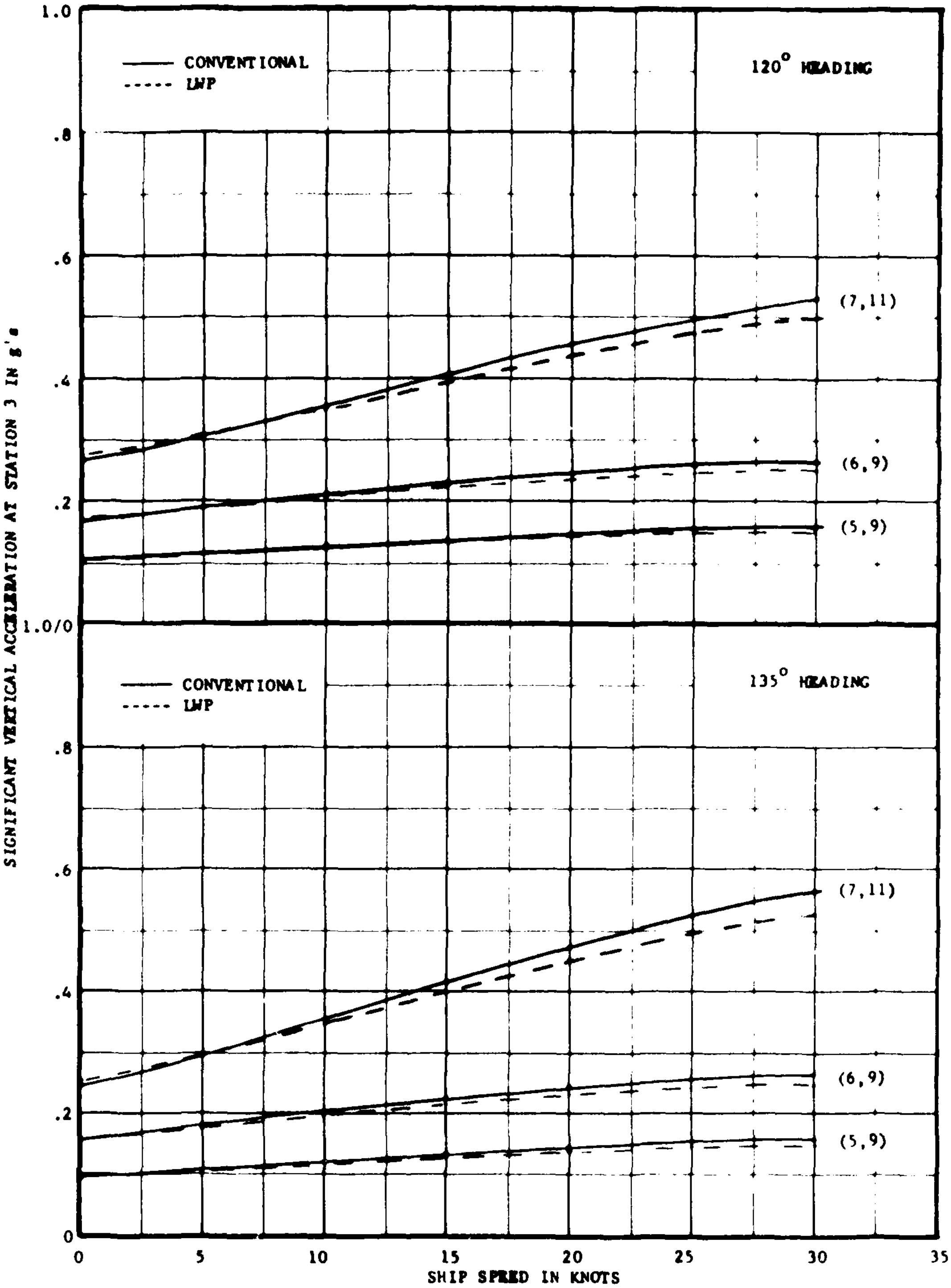

Figure 9e - For 120- and 135-Degree Headings

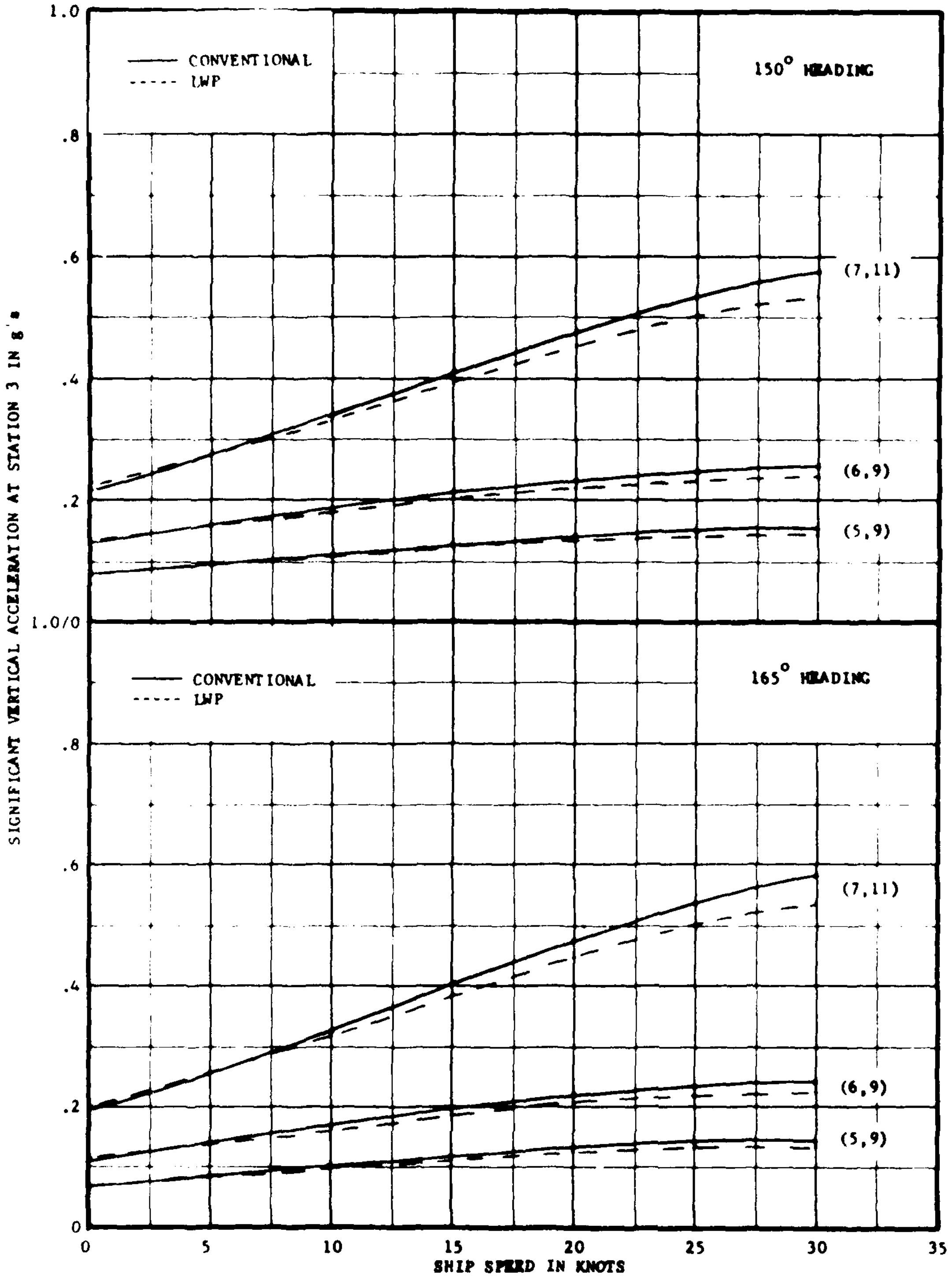

Figure 9f - For 150- and 165-Degree Headings

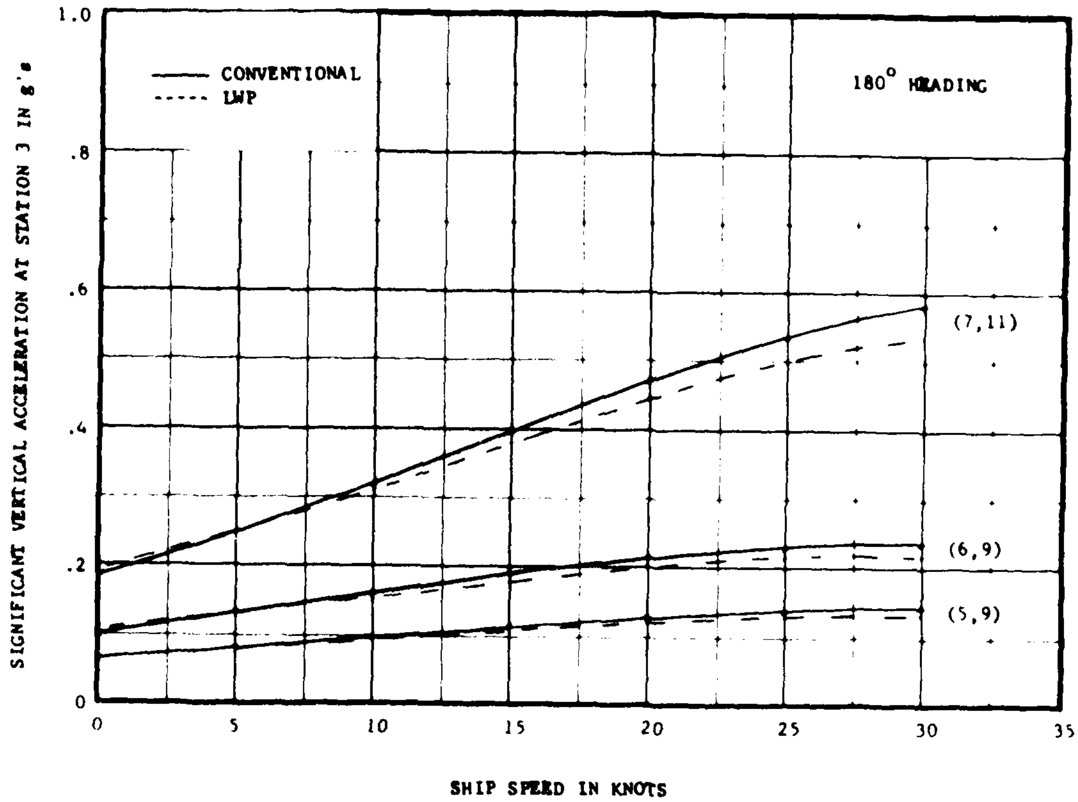

Figure 9g - For 180-Degree Heading

Figure 10 - Significant Acceleration at Station 8 for Various Headings

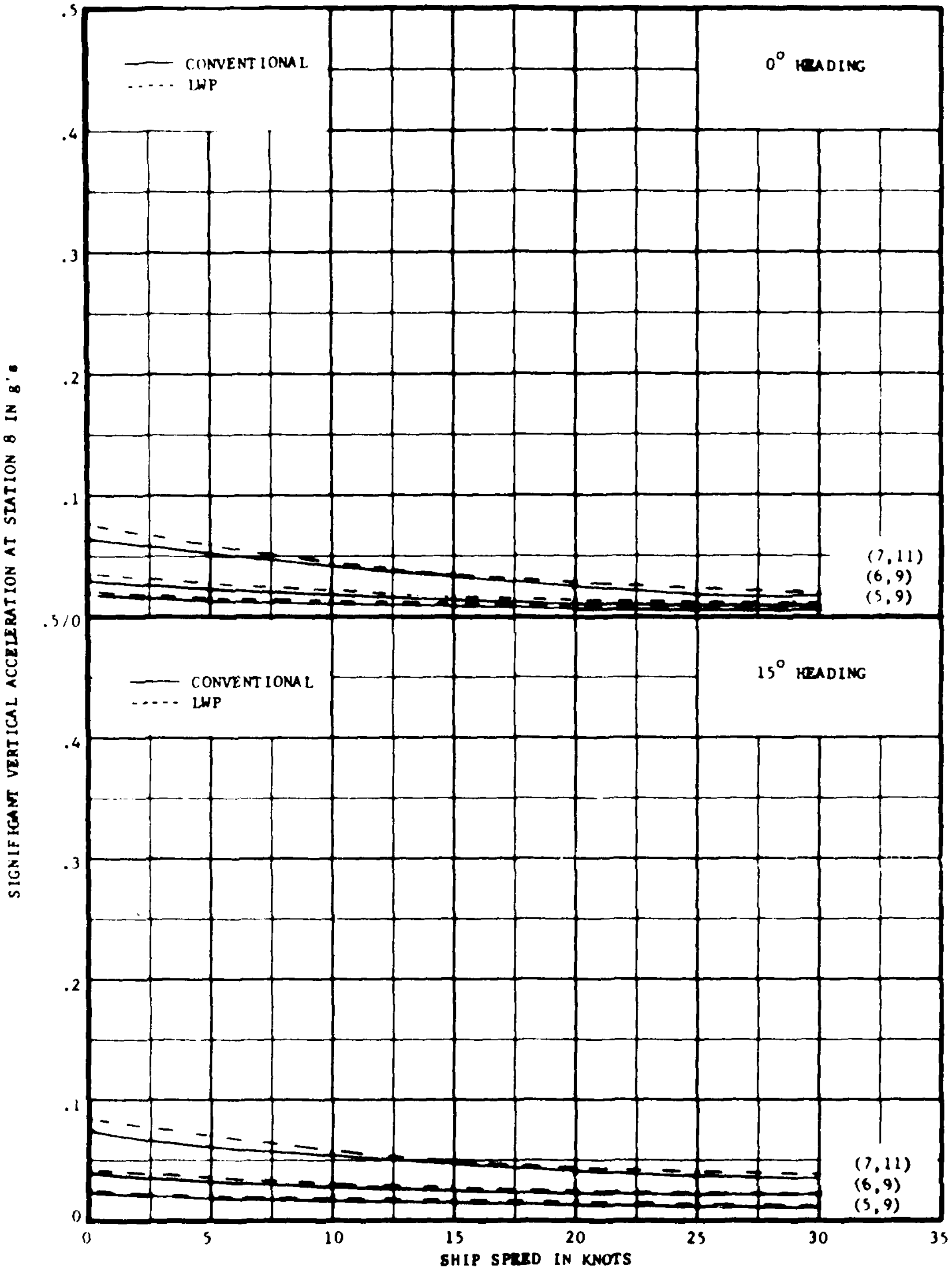

Figure 10a - For 0- and 15-Degree Headings

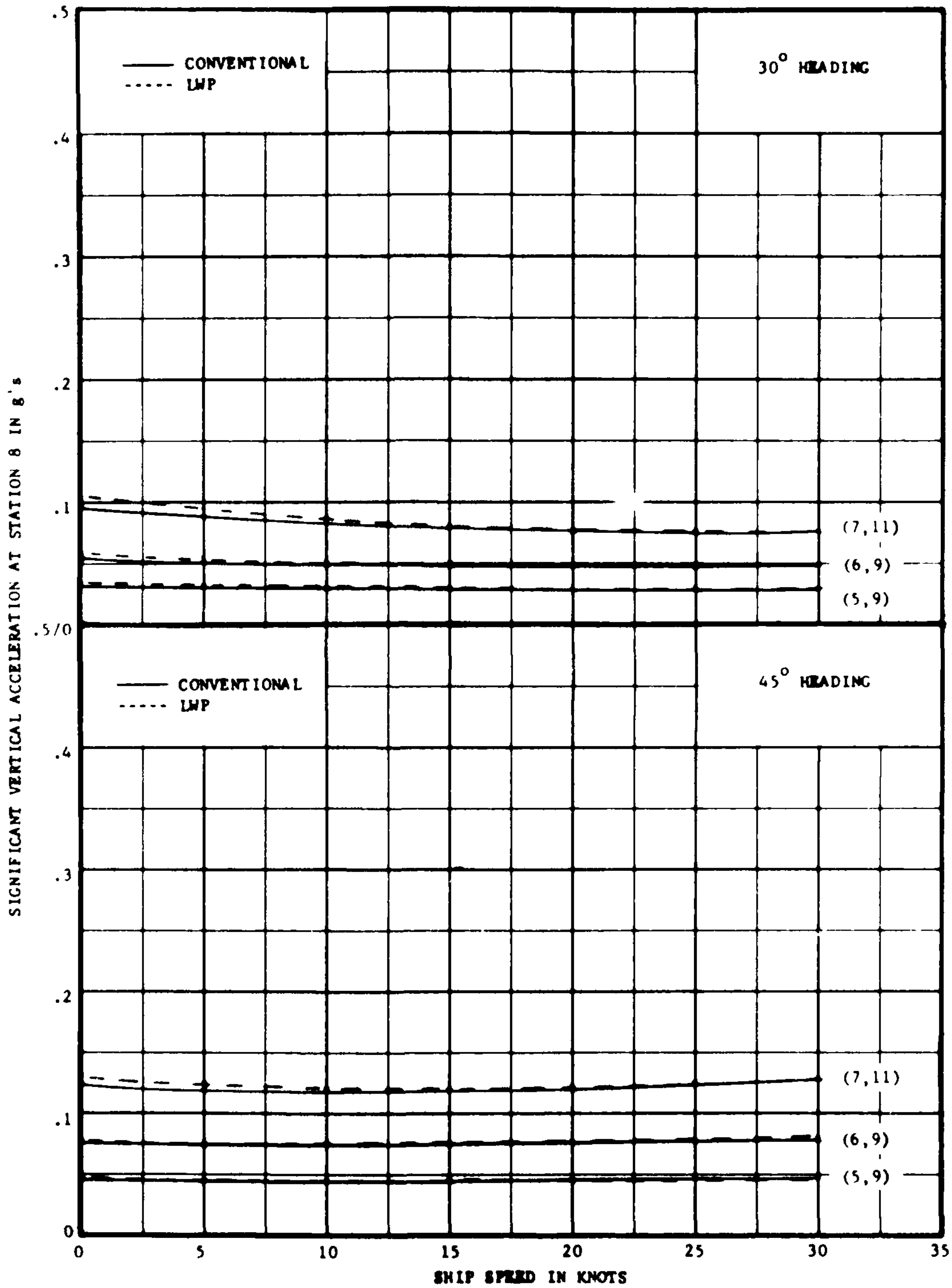

Figure 10b - For 30- and 45-Degree Headings

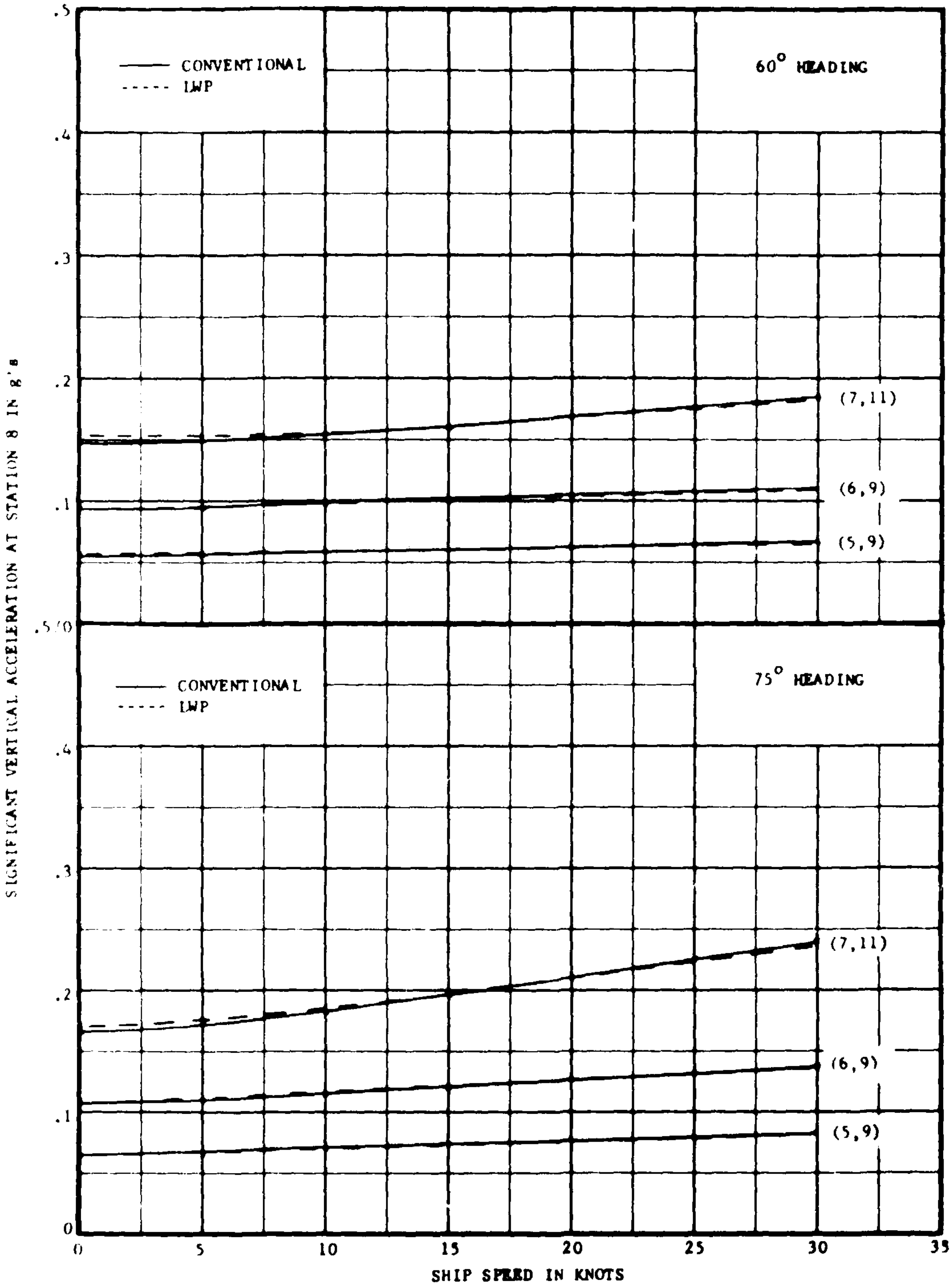

Figure 10c - For 60- and 75-Degree Headings

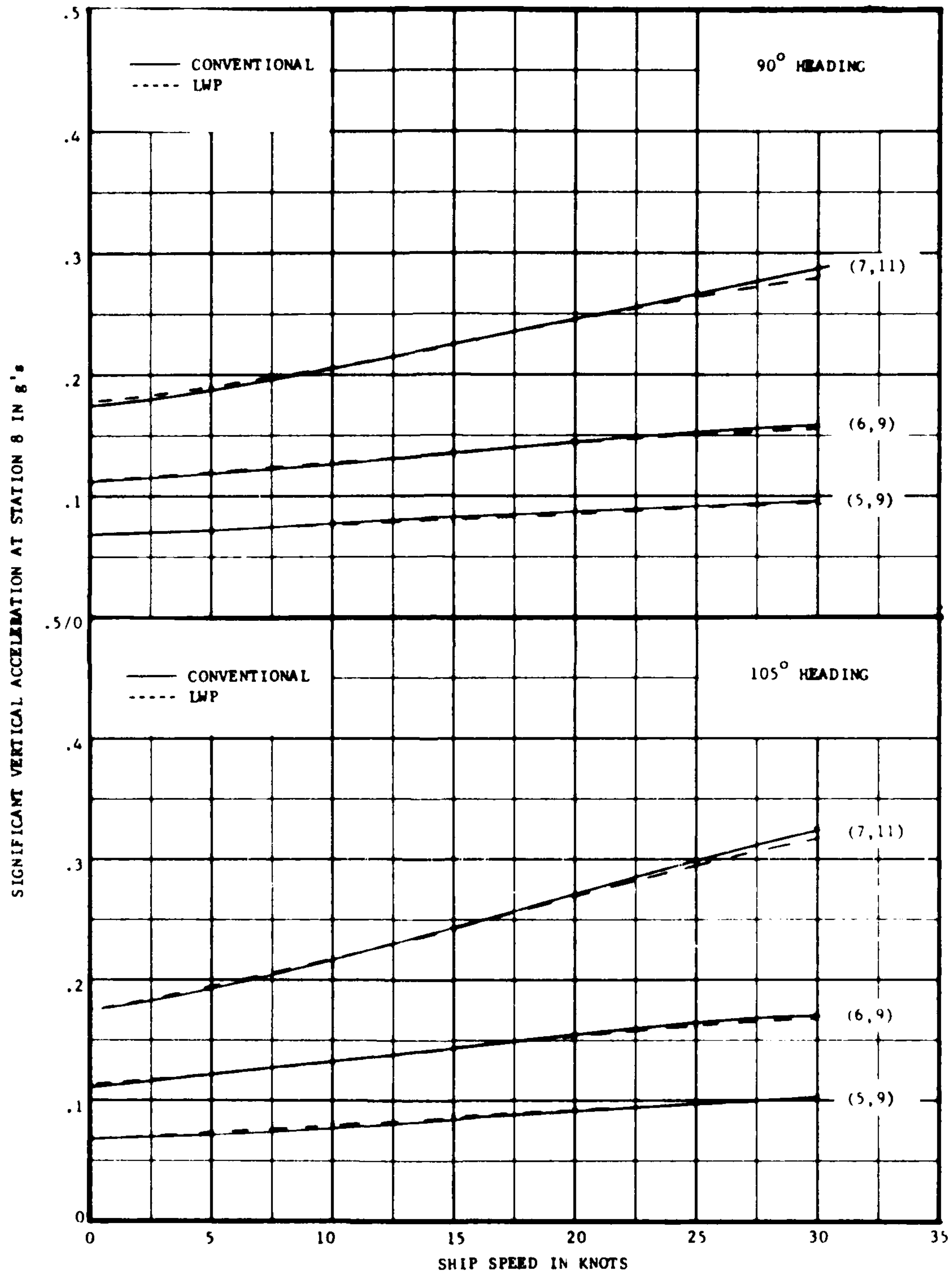

Figure 10d - For 90- and 105-Degree Headings

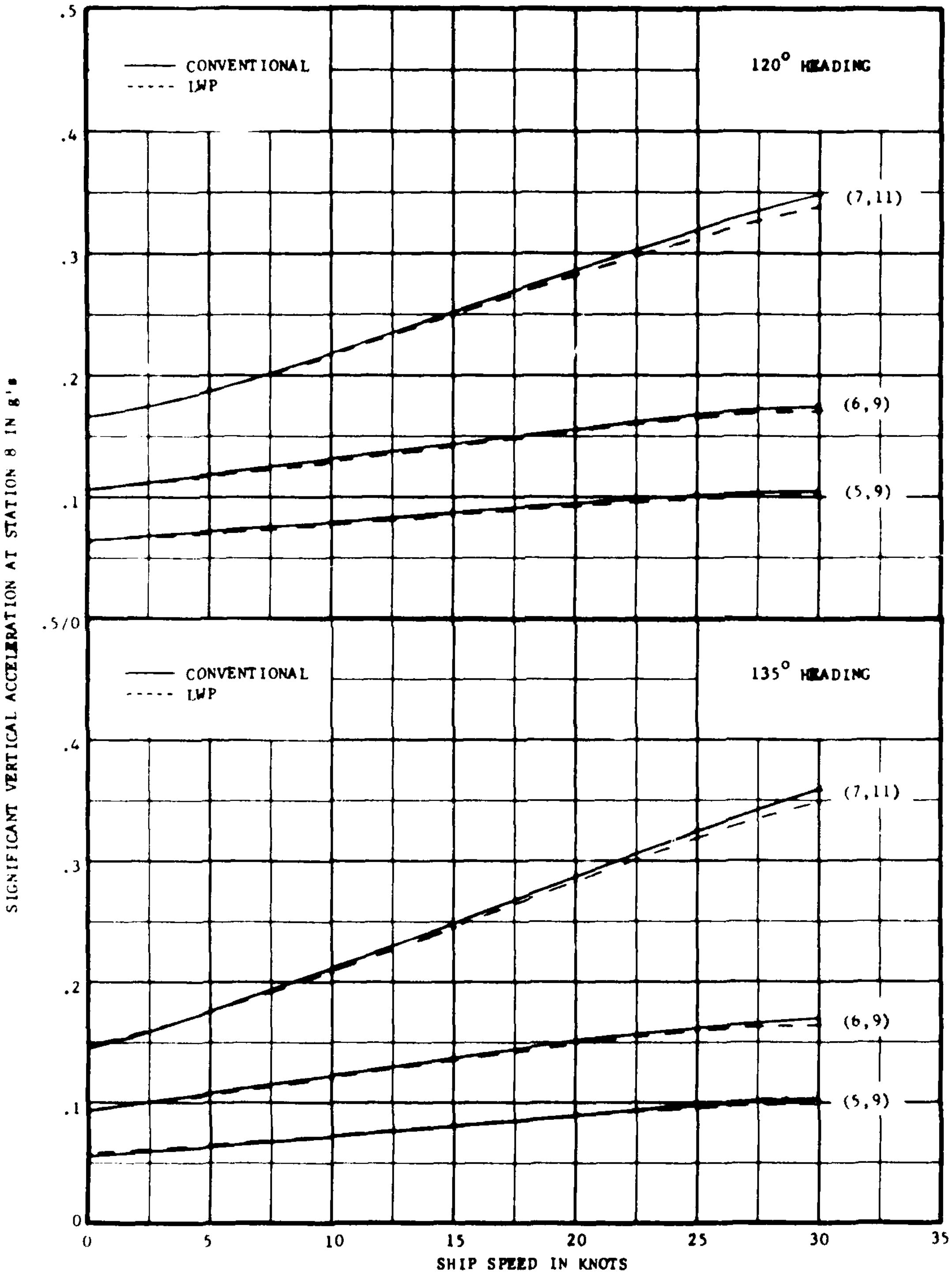

Figure 10e - For 120- and 135-Degree Headings

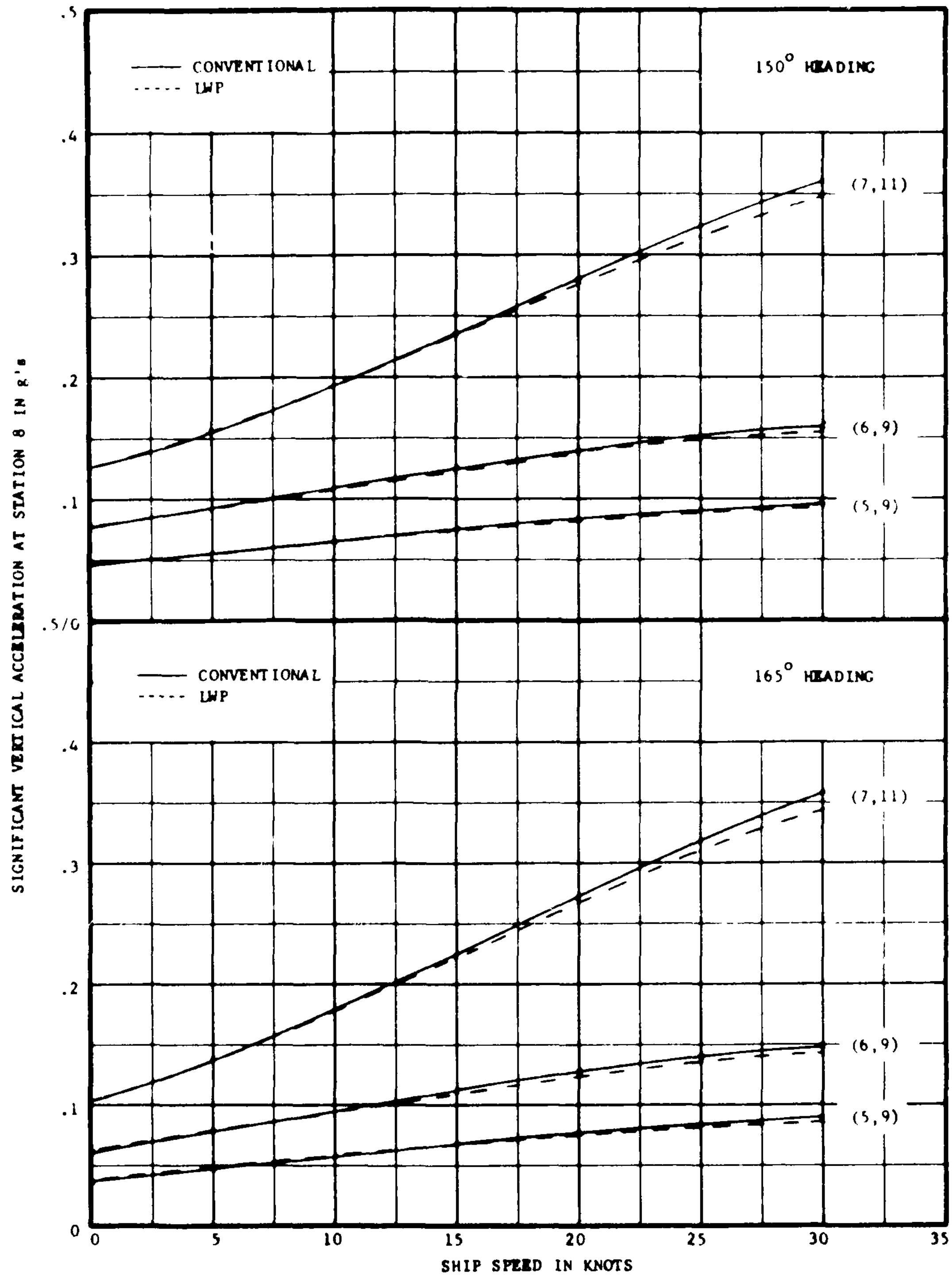

Figure 10f - For 150- and 165-Degree Headings

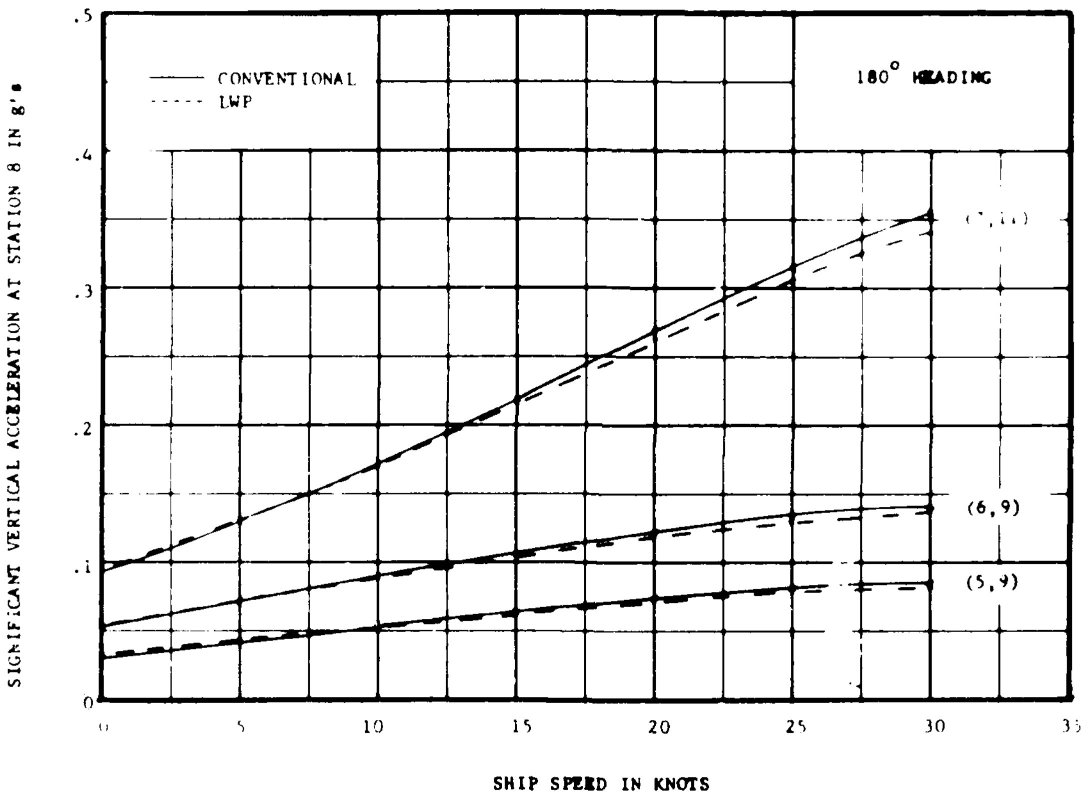

Figure 10g - For 180-Degree Heading

Figure 11 - Significant Acceleration at Station 15 for Various Headings

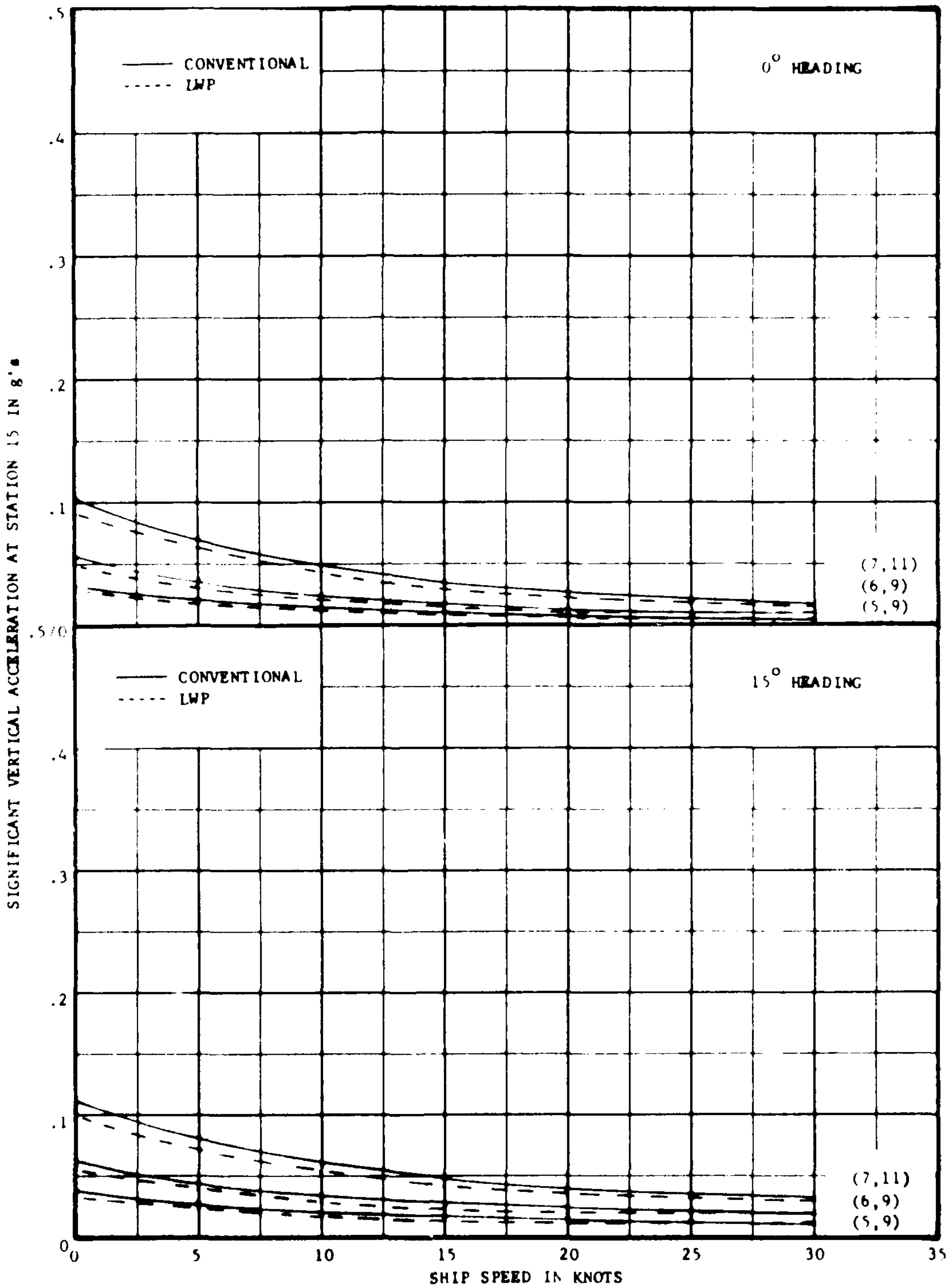

Figure 11a - For 0- and 15-Degree Headings

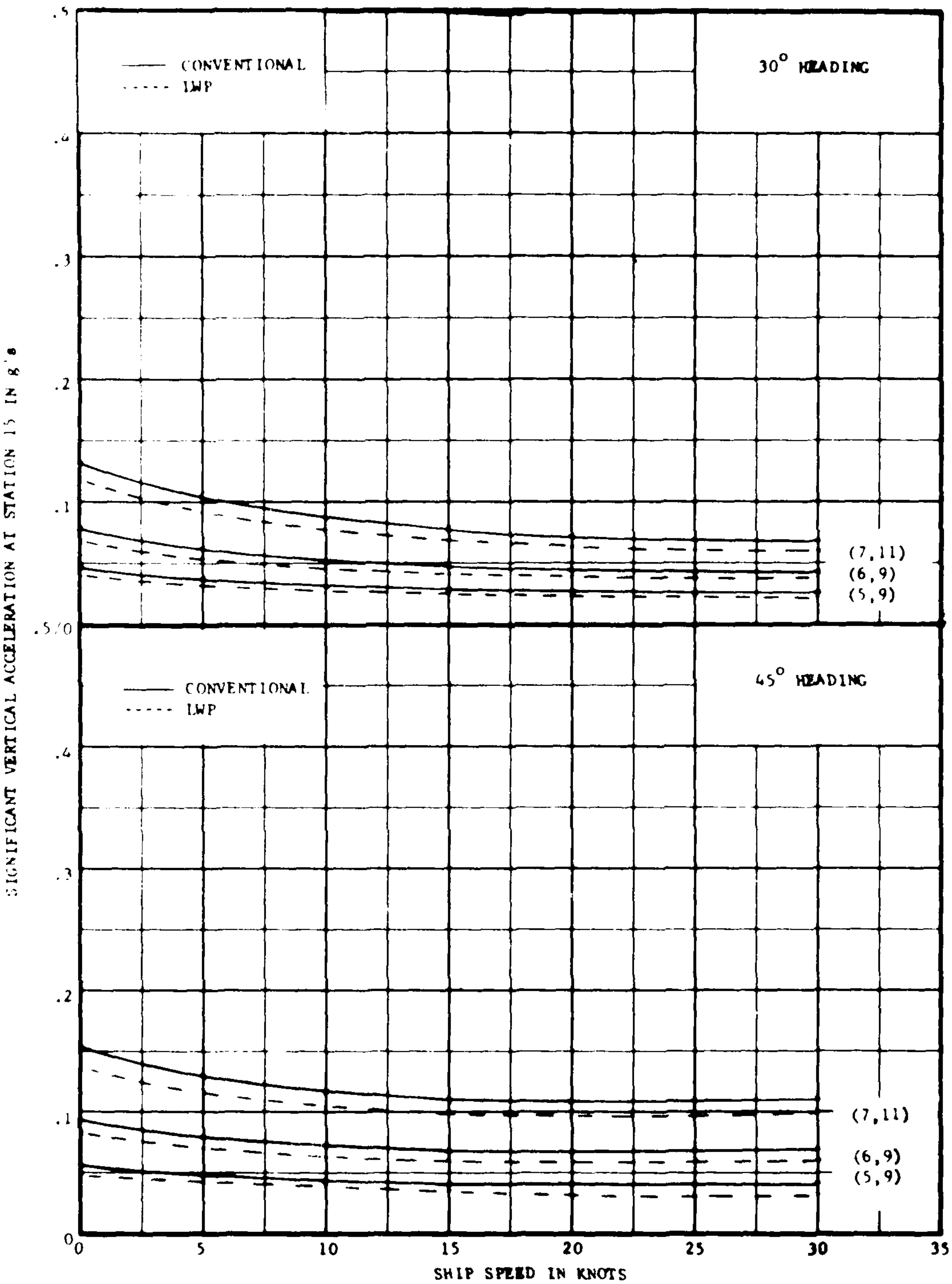

Figure 11b - For 30- and 45-Degree Headings

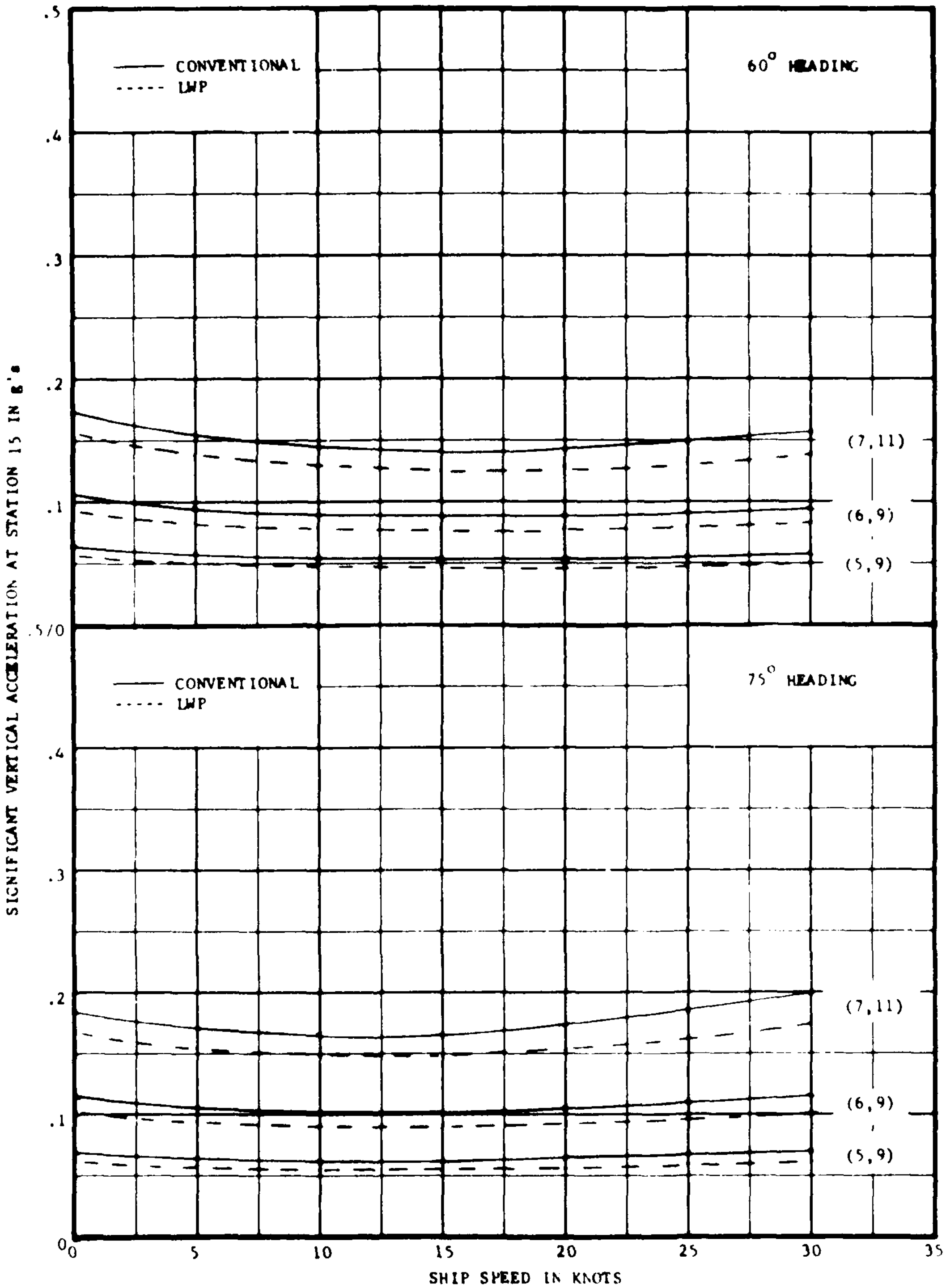

Figure 11c - For 60- and 75-Degree Headings

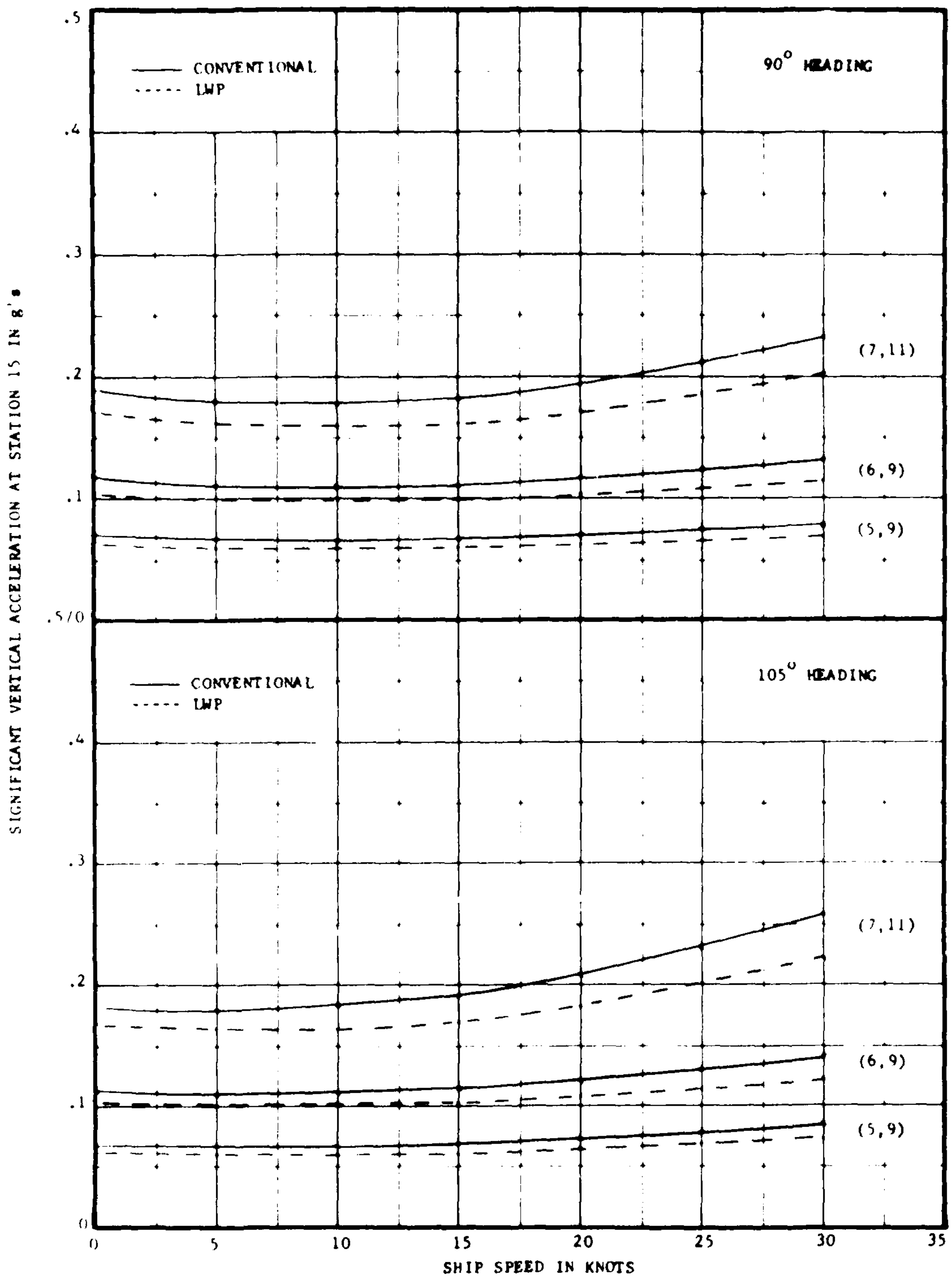

Figure 11d - For 90- and 105-Degree Headings

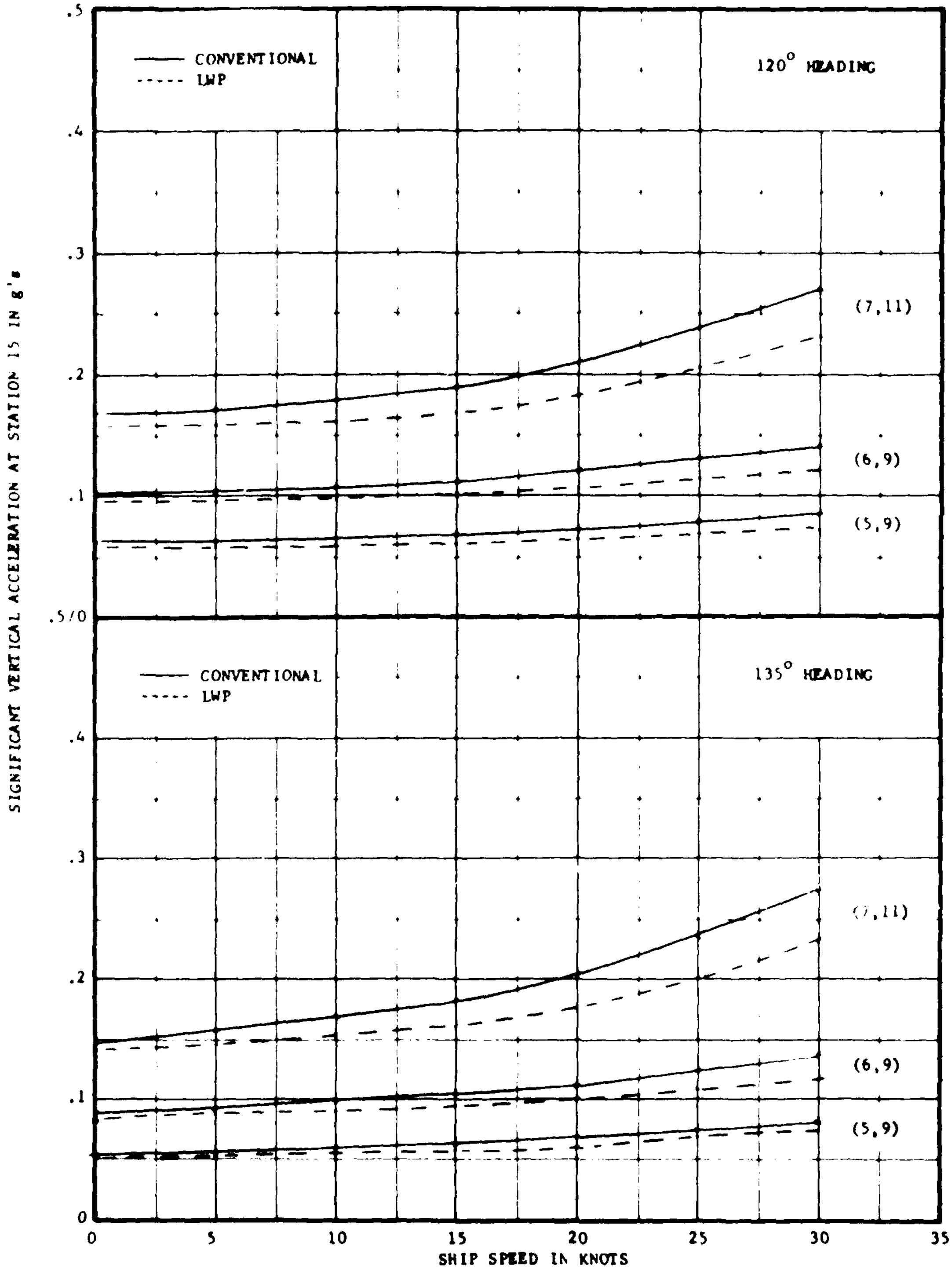

Figure 11e - For 120- and 135-Degree Headings

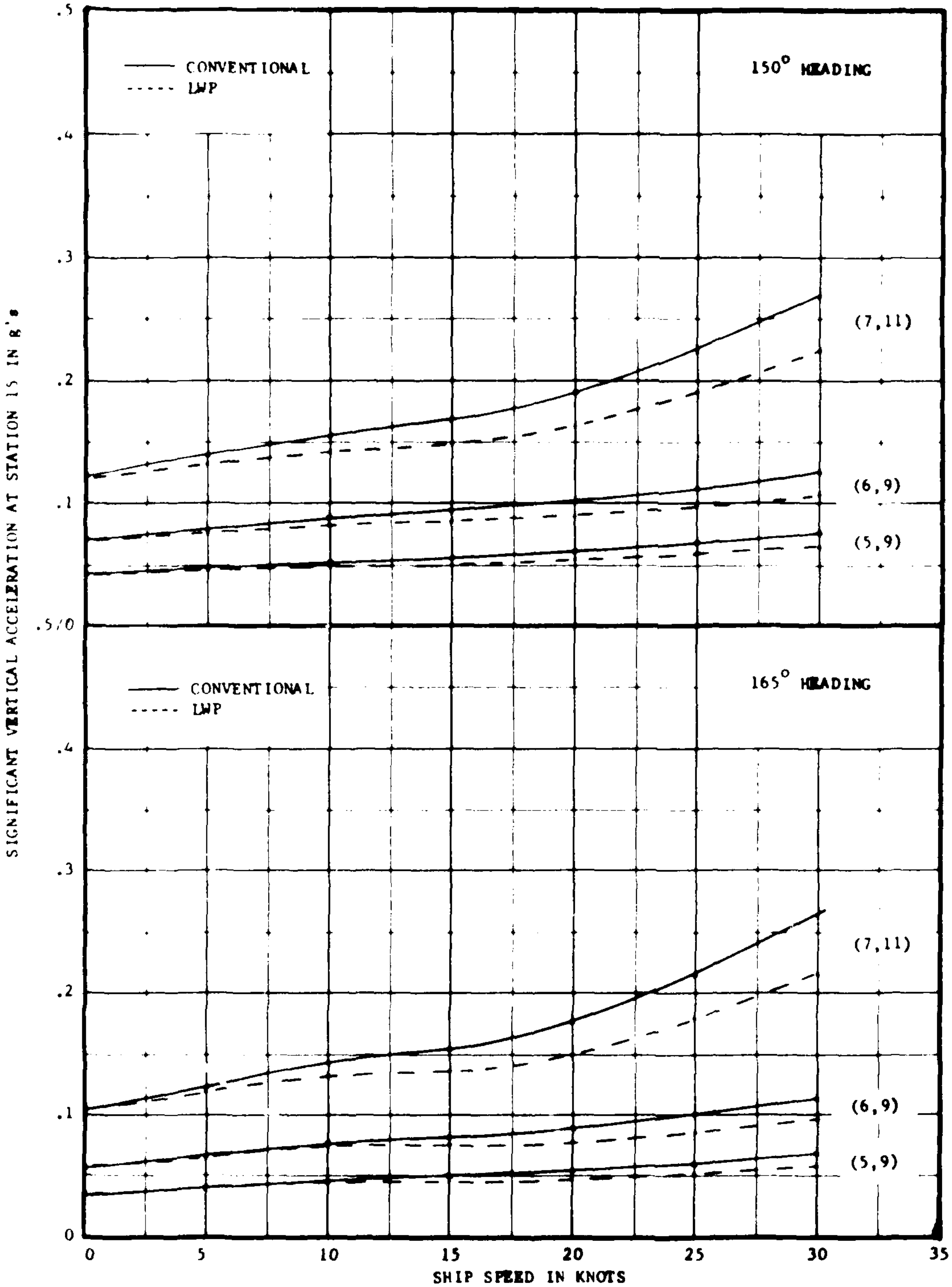

Figure 11f - For 150- and 165-Degree Headings

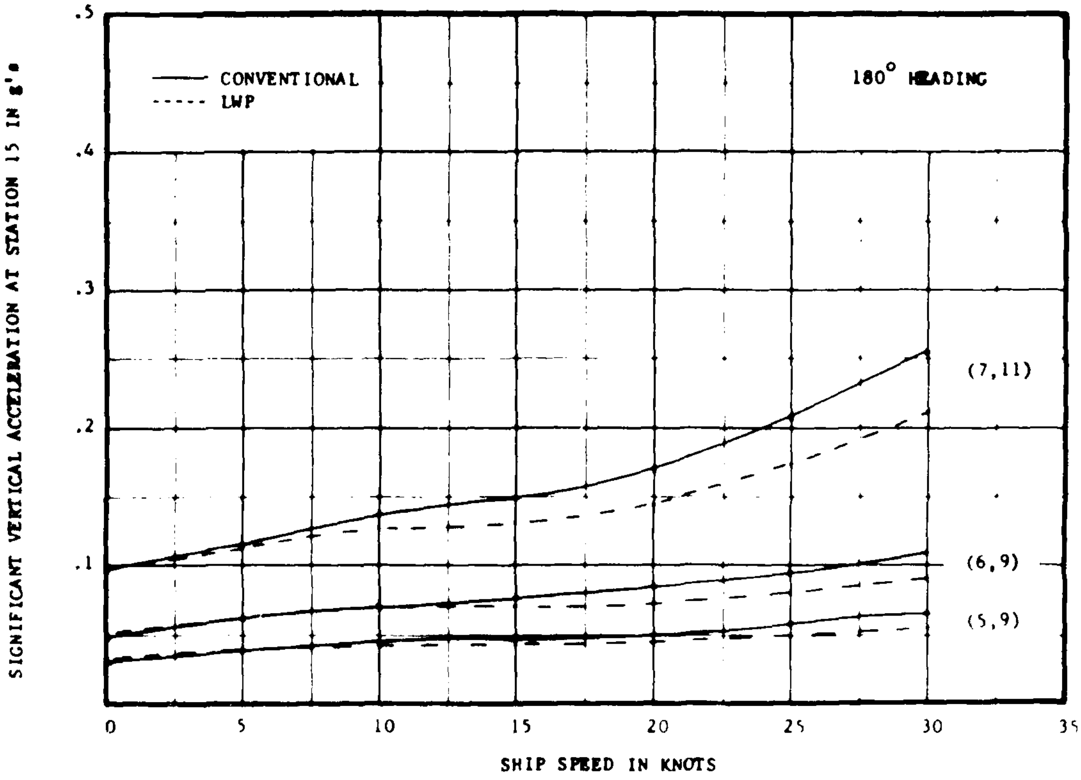

Figure 11g - For 180-Degree Heading

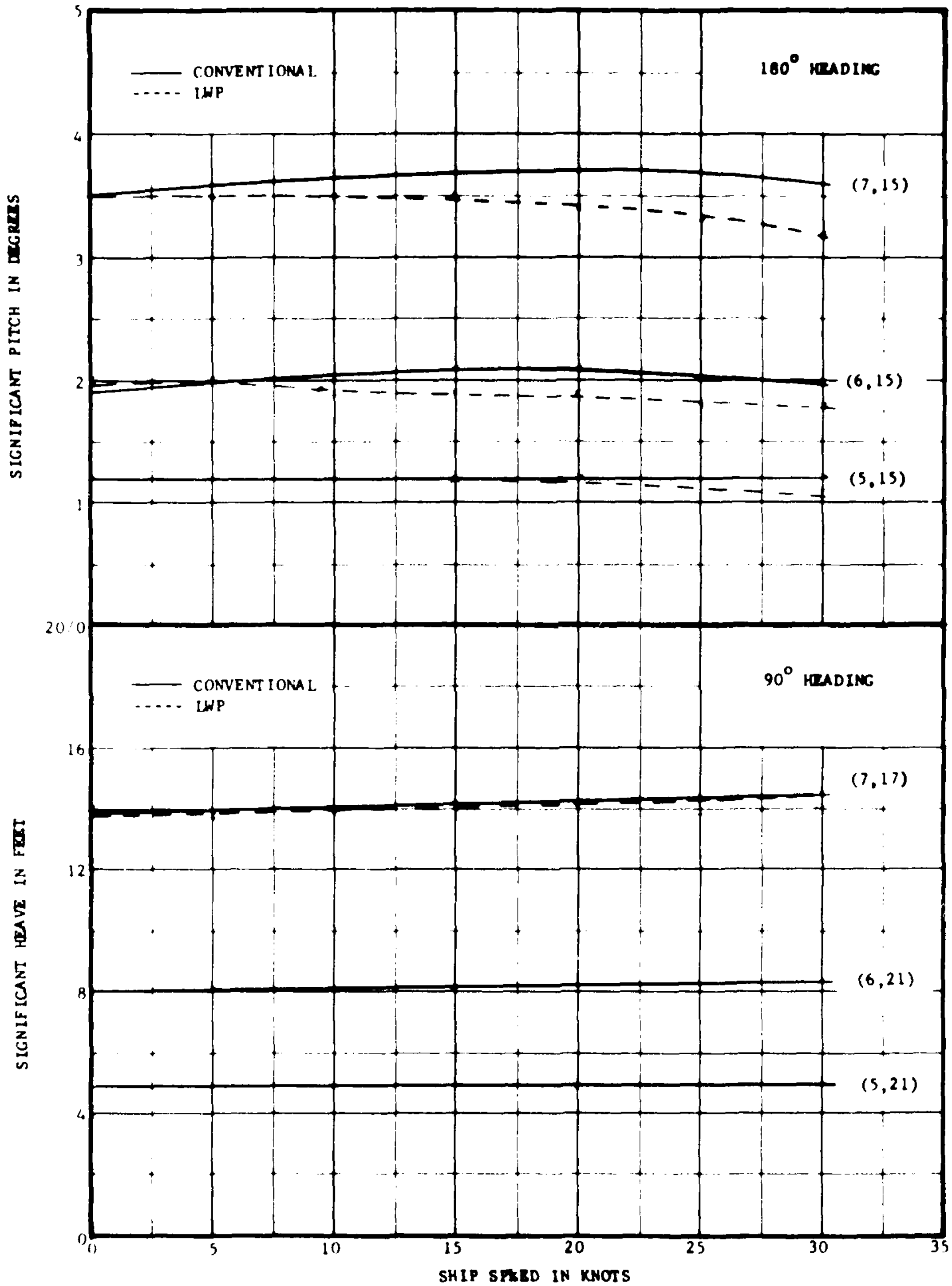

Figure 12 - Most Severe Significant Pitch and Heave

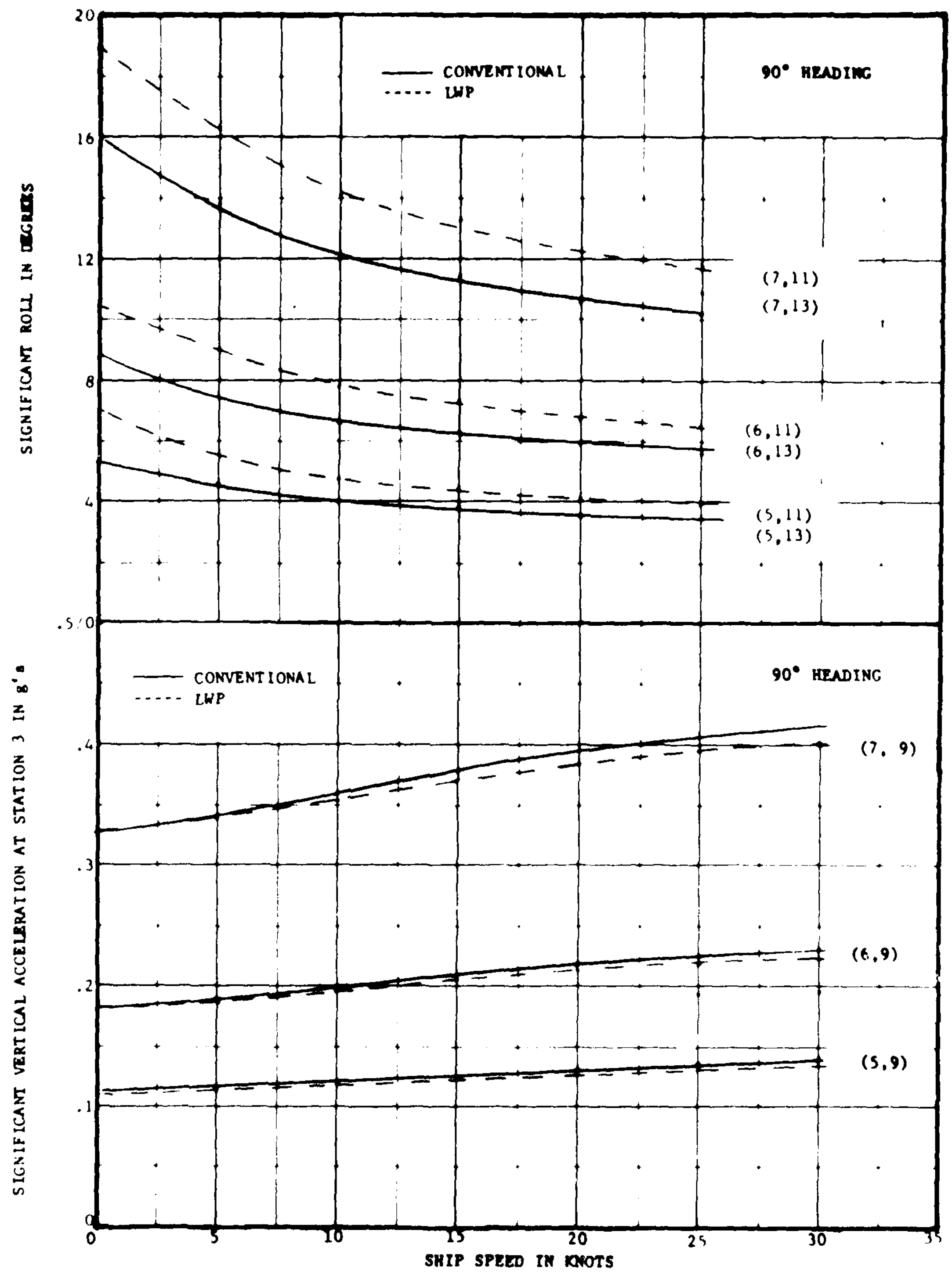

Figure 13 - Most Severe Significant Roll and Acceleration at Station 3

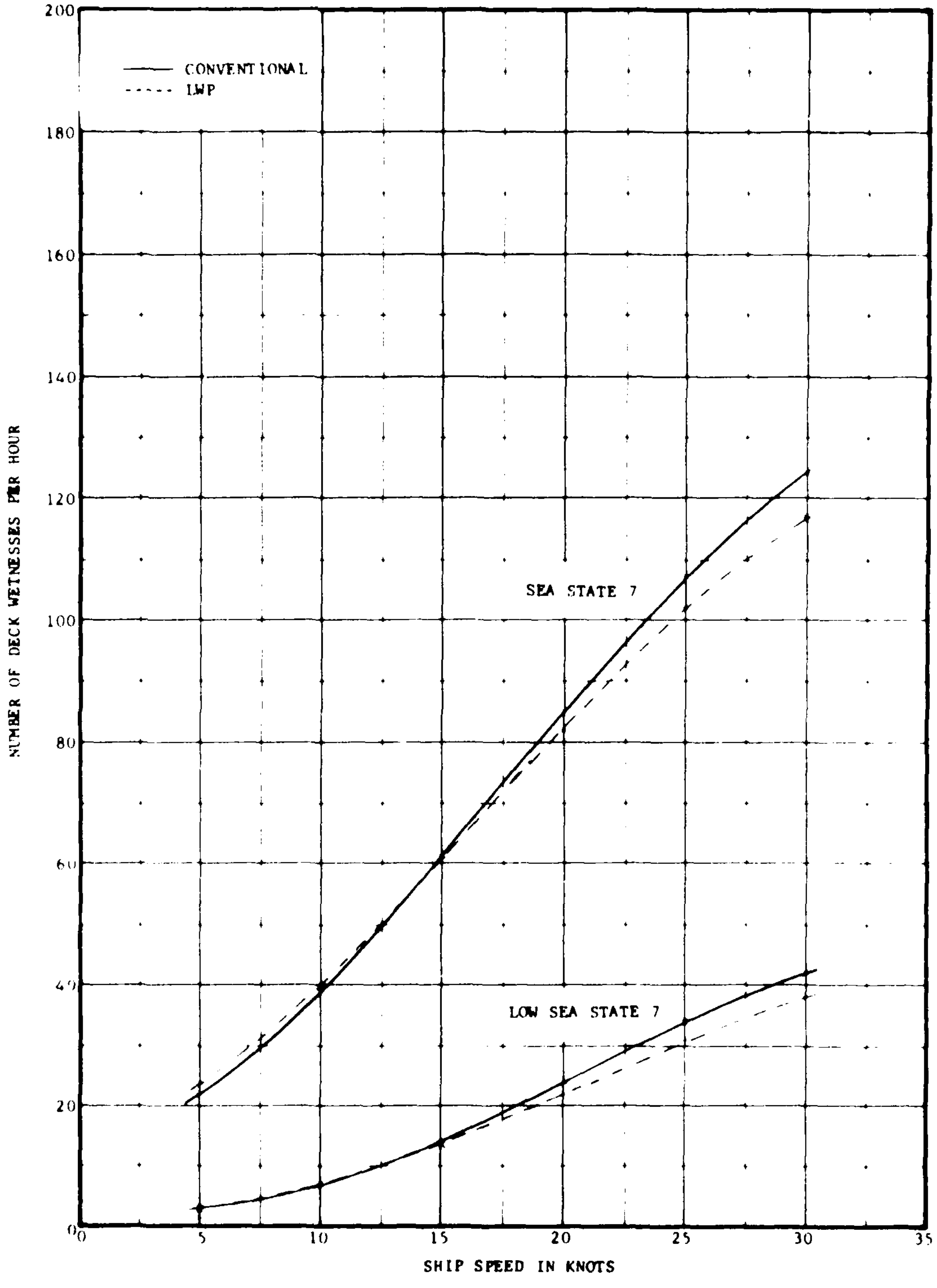

Figure 14 - Frequency of Deck Wetness

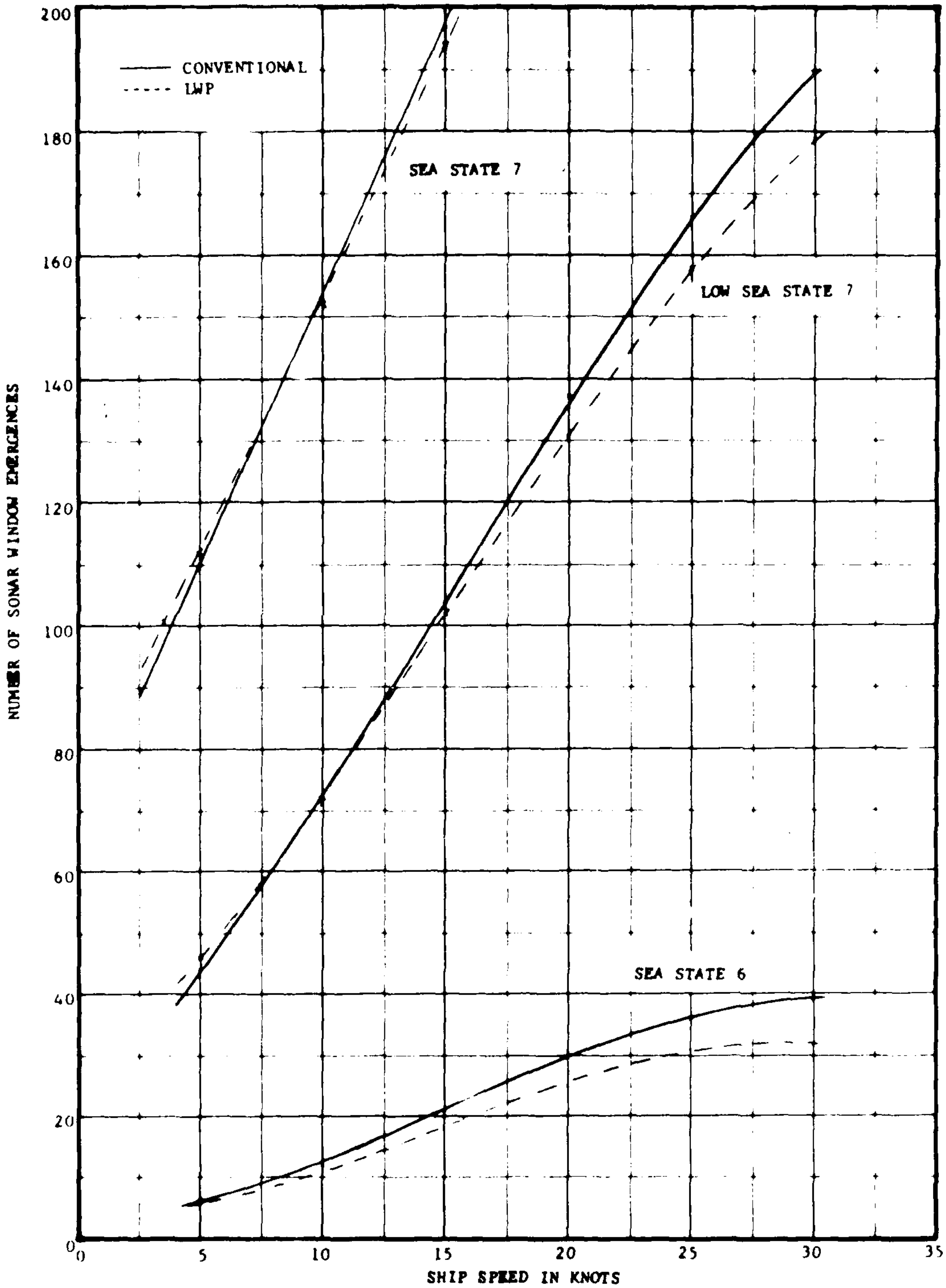

Figure 15 - Frequency of Sonar Dome Window Emergence

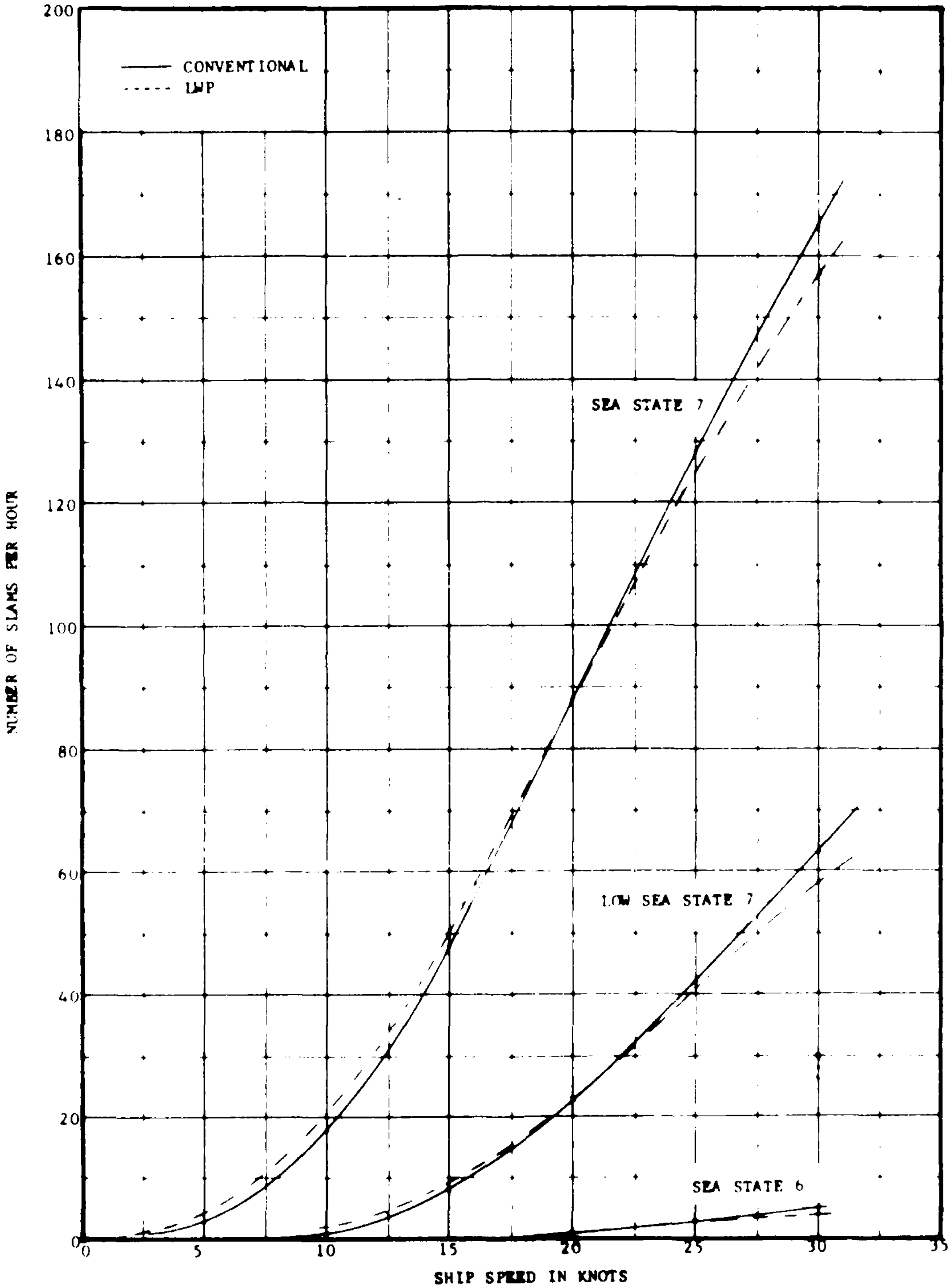

Figure 16 - Frequency of Slams

TABLE 1 - COMPUTER PREDICTED SHIP PARTICULARS

Parameter	Conventional Hull C17.2	Large Waterplane Hull C24.2
Displacement, S.W.	16,866 L. tons ($17,136 \times 10^3$ kg)	16,850 L. tons ($17,120 \times 10^3$ kg)
Length between Perpendiculars	666.0 ft (203.0 m)	666.0 ft (203.0 m)
Beam	76.46 ft (23.31 m)	74.66 ft (23.31 m)
Longitudinal Center of Gravity, LCG, aft of Midship	8.47 ft (2.58 m)	8.29 ft (2.53 m)
Transom Width	41.40 ft (12.62 m)	66.20 ft (20.18 m)
Waterplane Area	37,279 ft^2 (3,463 m^2)	39,575 ft^2 (3,676 m^2)
Vertical Center of Gravity, KG	28.00 ft (8.53 m)	28.20 ft (8.60 m)
Transverse Metacentric Height, GM	7.38 ft (2.25 m)	11.39 ft (3.47 m)
Vertical Center of Buoyancy, KB	13.01 ft (3.97 m)	13.31 ft (4.06 m)
Transverse Metacenter, KM	35.38 ft (10.78 m)	39.56 ft (12.06 m)
C_b	0.52	0.52
C_x	0.89	0.90
C_p	0.59	0.60

TABLE 2 - SEA CONDITIONS - MODAL PERIODS AND WAVE HEIGHTS

Modal Wave Period, seconds	7.0	9.0	11.0	13.0	15.0	17.0	19.0	21.0

NOTE: (A) All sea spectra have a 1.0-ft (0.30 m) significant wave height (double amplitude).

(B) Motion, velocity, and acceleration rms responses can be obtained for any sea state by multiplying the predicted rms values by the significant wave height of the sea.

TABLE 3 - CALCULATION CONDITIONS - SPEEDS AND HEADINGS

Ship Speed, knots	0	5	10	15	20	25	30
Heading, degrees	0	15	30	45	60	75	90
	105	120	135	150	165	180	

NOTE: 180 deg indicates head seas.

TABLE 4 - PREDICTED MOTIONS

A. Ship-Motion and Sea-Loads Program
(all headings, regular waves)

At ship center of gravity:

Surge, sway and heave - motion

Roll, pitch and yaw - angular motion

B. Irregular Seas Program
(all headings, irregular waves)

At ship center of gravity:

Surge, sway and heave - motion, velocity and acceleration

Roll, pitch and yaw - angular motion velocity and acceleration

At Station 3.0, 51.0 ft (15.54 m) above baseline (main deck)

At Station 8.0, 10 ft (3.05 m) off centerline, 90 ft (27.43 m) above baseline (pilothouse)

At Station 15.0, 51.5 (15.70 m) ft above baseline (main deck):

Surge, sway and heave - motion, velocity and acceleration

C. Pitch - Heave Motion Program
(head seas, regular and irregular waves)

At ship center of gravity:

Pitch, heave and relative motion

At Stations 0.0, 0.5, 1.0, and 3.0:

Vertical motion, velocity, and acceleration

Relative motion and velocity

TABLE 5 - PROBABILITY THAT SEA STATES 5, 6, AND 7 WILL BE EXCEEDED

Sea State	Significant Wave Height ft	m	Probability of Exceeding the Wave Height: North Atlantic (winter) percent	Worldwide (all season) percent
5	10.2	3.1	30.5	15.0
6	16.9	5.1	6.5	1.0
7	30.6	9.3	< 0.5	< 0.0

TABLE 6 - RMS PITCH IN SHORT-CRESTED SEAS

CSGN - CONVENTIONAL HULL

SHORTCRESTED

RMS PITCH IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{0E}, IN SECONDS

V	T	0	15	30	45	60	75	90	105	120	135	150	165	180
		SHIP HEADING ANGLE IN DEGREES												
0	7	.019/ 7.9	.021/ 7.9	.025/ 7.5	.029/ 7.5	.033/ 7.3	.036/ 7.3	.038/ 7.3	.037/ 7.3	.035/ 7.3	.031/ 7.5	.027/ 7.5	.023/ 7.5	.021/ 7.5
	9	.034/10.5	.036/10.5	.037/10.5	.040/10.5	.043/ 9.5	.046/ 9.2	.047/ 9.0	.047/ 9.2	.045/ 9.5	.043/ 9.0	.040/10.5	.038/10.5	.037/10.5
	11	.046/11.6	.047/11.6	.047/11.6	.047/11.2	.048/11.2	.049/10.8	.049/10.8	.050/10.8	.050/11.2	.050/11.2	.050/11.6	.050/11.6	.050/11.6
	13	.053/12.6	.053/12.6	.051/12.6	.050/12.6	.048/12.1	.048/12.1	.048/11.6	.049/12.1	.051/12.1	.053/12.6	.054/12.6	.056/12.6	.056/12.6
	15	.054/14.0	.054/14.0	.052/14.0	.049/14.0	.046/12.6	.045/12.6	.044/12.6	.046/12.6	.048/12.6	.051/14.0	.054/14.0	.056/14.0	.057/14.0
	17	.052/14.0	.052/14.0	.050/14.0	.046/14.0	.043/14.0	.041/14.0	.040/14.0	.042/14.0	.045/14.0	.048/14.0	.052/14.0	.054/14.0	.055/14.0
	19	.049/15.7	.048/15.7	.046/15.7	.043/15.7	.040/15.7	.037/15.7	.036/14.0	.038/14.0	.041/15.7	.044/15.7	.048/15.7	.050/15.7	.051/15.7
	21	.046/15.7	.045/15.7	.043/15.7	.039/15.7	.036/15.7	.033/15.7	.032/15.7	.034/15.7	.037/15.7	.041/15.7	.044/15.7	.046/15.7	.047/15.7
5	7	.017/ 9.5	.019/ 9.5	.022/ 9.5	.027/ 7.9	.031/ 7.9	.034/ 7.9	.035/ 7.9	.035/ 7.5	.033/ 7.5	.030/ 7.9	.026/ 7.9	.022/ 7.9	.020/ 7.9
	9	.030/12.6	.031/12.1	.033/12.1	.037/12.1	.040/10.5	.043/ 9.5	.045/ 9.2	.046/ 9.5	.045/ 9.5	.043/ 9.0	.041/10.5	.039/10.5	.038/10.5
	11	.042/13.4	.043/13.4	.043/13.4	.044/13.1	.045/12.6	.046/12.1	.048/11.2	.049/10.8	.051/10.8	.051/11.2	.052/11.6	.052/11.6	.052/11.6
	13	.049/14.3	.048/14.3	.048/14.3	.046/14.0	.045/13.7	.045/13.1	.047/12.6	.049/12.1	.051/12.6	.054/12.6	.056/12.6	.057/12.6	.058/12.6
	15	.053/15.7	.050/15.7	.048/15.3	.046/15.3	.044/14.6	.043/14.9	.043/13.7	.045/12.8	.049/12.8	.052/14.0	.056/14.0	.058/14.0	.058/14.0
	17	.049/15.7	.048/15.7	.046/15.7	.044/15.7	.041/15.7	.039/15.[illegible]	.039/14.0	.042/14.0	.045/14.0	.049/14.0	.053/14.0	.055/14.0	.056/14.0
	19	.046/17.5	.045/17.5	.043/17.5	.040/17.0	.037/17.0	.035/15.7	.035/15.7	.037/15.3	.041/15.7	.045/15.7	.049/15.7	.051/15.7	.052/15.7
	21	.043/17.5	.042/17.5	.040/17.5	.037/17.5	.034/17.5	.032/17.0	.032/16.1	.034/15.7	.037/15.7	.041/15.7	.045/15.7	.047/15.7	.048/15.7
10	7	.015/13.4	.016/13.4	.020/10.1	.025/ 7.9	.029/ 7.9	.031/ 7.9	.033/ 7.9	.032/ 7.9	.031/ 7.9	.027/ 7.9	.023/ 7.9	.020/ 7.9	.019/ 7.9
	9	.027/15.0	.028/15.0	.031/15.0	.034/13.4	.038/12.1	.041/10.1	.043/ 9.5	.044/ 9.5	.044/ 9.5	.043/ 9.0	.041/10.5	.039/10.5	.039/10.5
	11	.039/15.7	.039/15.7	.040/15.7	.040/15.7	.042/15.3	.044/13.4	.047/11.2	.049/10.8	.051/10.8	.052/11.2	.053/11.2	.053/11.2	.053/11.2
	13	.045/16.5	.045/16.5	.044/16.5	.043/16.5	.043/16.1	.044/15.3	.045/13.4	.048/12.6	.051/12.1	.055/12.6	.057/12.6	.059/12.6	.059/12.6
	15	.047/17.5	.046/17.5	.045/17.5	.043/17.0	.041/17.0	.041/16.1	.042/14.6	.045/14.0	.049/14.0	.053/14.0	.057/14.0	.059/14.0	.060/14.0
	17	.046/18.5	.045/18.5	.043/18.0	.041/18.0	.039/17.5	.038/17.0	.038/15.7	.041/14.0	.045/14.0	.050/14.0	.054/14.0	.056/14.0	.057/14.0
	19	.043/19.6	.043/19.6	.041/19.0	.038/19.0	.035/18.5	.034/18.0	.035/16.5	.037/15.7	.041/15.7	.046/15.7	.050/15.7	.052/15.7	.053/15.7
	21	.040/19.6	.040/19.6	.038/19.6	.035/19.6	.032/19.6	.031/18.5	.031/18.0	.034/15.7	.037/15.7	.042/15.7	.045/15.7	.048/15.7	.049/15.7
15	7	.013/17.5	.015/17.5	.018/11.6	.023/ 8.3	.026/ 8.3	.029/ 8.3	.030/ 8.3	.030/ 8.3	.028/ 8.3	.025/ 8.3	.021/ 8.3	.018/ 8.8	.017/ 9.0
	9	.025/17.5	.026/17.5	.028/17.5	.031/17.5	.035/15.0	.039/ 9.0	.041/ 9.2	.043/ 9.5	.043/ 9.5	.042/ 9.0	.040/10.5	.039/10.8	.038/10.5
	11	.036/20.3	.036/20.3	.037/20.3	.038/20.3	.040/19.6	.042/15.3	.045/11.6	.048/11.2	.050/11.2	.052/11.2	.053/11.2	.054/11.2	.054/11.2
	13	.042/20.3	.042/20.3	.041/20.3	.040/20.3	.040/20.3	.042/16.0	.044/12.6	.048/12.6	.051/12.1	.055/12.1	.058/12.1	.060/12.6	.060/12.6
	15	.044/20.3	.043/20.3	.042/20.3	.040/20.3	.039/20.3	.039/19.6	.041/15.7	.045/14.0	.049/14.0	.054/14.0	.057/14.0	.060/14.0	.061/14.0
	17	.043/20.9	.042/20.9	.041/20.9	.038/20.3	.037/20.3	.036/20.3	.038/16.0	.041/15.7	.046/14.0	.050/14.0	.054/14.0	.057/14.0	.058/14.0
	19	.041/21.7	.040/21.7	.038/21.7	.036/21.7	.034/20.9	.033/20.3	.034/18.5	.037/15.7	.042/15.7	.046/15.7	.050/15.7	.053/15.7	.054/15.7
	21	.039/21.7	.037/21.7	.035/21.7	.033/21.7	.031/21.7	.030/20.9	.030/19.6	.033/18.0	.038/15.7	.042/15.7	.046/15.7	.048/15.7	.049/15.7
20	7	.012/13.4	.013/13.4	.017/13.4	.021/13.4	.024/13.4	.026/13.4	.028/ 8.7	.027/ 8.7	.025/ 8.9	.022/ 8.9	.019/ 8.9	.016/ 9.0	.015/ 9.2
	9	.023/23.3	.024/23.3	.026/23.3	.029/19.0	.033/19.0	.036/19.0	.039/ 9.5	.041/ 9.5	.041/ 9.8	.040/10.5	.039/10.5	.037/10.5	.037/10.5
	11	.033/23.3	.033/23.3	.034/23.3	.035/23.3	.037/23.3	.040/19.0	.043/19.0	.047/10.8	.049/10.8	.051/11.2	.053/11.2	.053/11.2	.054/11.6
	13	.039/23.3	.039/23.3	.038/23.3	.038/23.3	.038/23.3	.040/23.3	.043/19.0	.047/11.6	.051/12.1	.055/12.1	.058/12.1	.060/12.6	.061/12.6
	15	.041/26.2	.040/26.2	.039/26.2	.038/23.3	.037/23.3	.038/23.3	.040/23.3	.044/14.0	.049/14.0	.054/12.6	.057/12.6	.060/14.0	.061/14.0
	17	.040/26.2	.039/26.2	.038/26.2	.036/26.2	.035/23.3	.035/23.3	.037/23.3	.041/19.0	.045/14.0	.050/14.0	.054/14.0	.057/14.0	.058/14.0
	19	.039/26.2	.037/26.2	.036/26.2	.034/26.2	.032/26.2	.031/23.3	.033/23.3	.037/15.7	.041/15.7	.046/15.7	.050/15.7	.053/15.7	.054/15.7
	21	.035/27.3	.035/27.3	.033/27.3	.031/26.2	.029/26.2	.028/23.3	.030/23.3	.033/19.0	.037/15.7	.042/15.7	.046/15.7	.048/15.7	.049/15.7
25	7	.011/16.5	.013/16.5	.016/16.5	.019/16.5	.022/16.5	.025/16.5	.025/16.5	.025/16.5	.023/16.5	.020/ 9.2	.017/ 9.0	.014/ 9.0	.013/ 9.2
	9	.022/16.5	.022/16.5	.025/16.5	.028/16.5	.031/16.5	.035/16.5	.037/16.5	.038/16.5	.039/16.5	.038/10.5	.037/10.5	.035/10.5	.035/10.5
	11	.031/33.1	.031/33.1	.032/16.5	.033/16.5	.036/16.5	.038/16.5	.042/16.5	.045/16.5	.048/11.2	.050/11.2	.051/11.6	.052/11.6	.052/11.6
	13	.037/33.1	.036/33.1	.036/33.1	.036/33.1	.036/16.5	.038/16.5	.042/16.5	.046/16.5	.050/12.1	.054/12.1	.057/12.6	.059/12.6	.060/12.6
	15	.039/33.1	.038/33.1	.037/33.1	.036/33.1	.035/33.1	.036/26.2	.039/16.5	.043/16.5	.048/12.6	.053/12.6	.057/12.6	.060/14.0	.060/14.0
	17	.039/33.1	.037/33.1	.036/33.1	.034/[illegible]	.033/33.1	.033/26.2	.036/16.5	.040/16.5	.045/16.5	.050/14.0	.054/14.0	.057/14.0	.058/14.0
	19	.036/33.1	.035/33.1	.034/33.1	.032/33.1	.030/33.1	.030/33.1	.032/26.2	.036/16.5	.041/16.5	.046/15.7	.050/15.7	.053/15.7	.054/15.7
	21	.033/33.1	.033/33.1	.031/33.1	.029/33.1	.028/33.1	.027/33.1	.029/26.2	.032/16.5	.037/16.5	.042/16.5	.046/15.7	.048/15.7	.049/15.7
30	7	.011/20.3	.012/20.3	.015/10.5	.019/10.5	.022/10.5	.023/10.5	.024/10.5	.023/10.5	.022/10.5	.019/10.5	.015/ 8.5	.012/ 9.0	.011/ 9.2
	9	.022/20.3	.022/20.3	.024/20.3	.027/20.3	.030/20.3	.033/20.3	.035/20.3	.037/10.5	.037/10.5	.036/10.5	.034/10.0	.033/10.0	.032/10.5
	11	.033/20.6	.031/20.6	.031/20.3	.032/20.3	.034/20.3	.037/20.3	.040/20.3	.043/20.3	.046/11.2	.048/11.6	.049/11.6	.050/11.6	.051/11.6
	13	.039/41.9	.039/41.9	.035/20.6	.034/20.6	.035/20.6	.037/20.3	.040/20.3	.044/20.3	.049/12.1	.053/12.1	.050/12.6	.058/12.6	.059/12.6
	15	.037/34.9	.036/34.9	.035/34.9	.034/34.9	.034/20.6	.035/20.6	.038/20.6	.042/20.3	.047/12.6	.052/12.6	.056/14.0	.059/14.0	.059/14.0
	17	.036/34.9	.035/34.9	.034/34.9	.033/34.9	.031/34.9	.032/34.9	.035/20.6	.039/20.3	.044/14.0	.049/14.0	.053/14.0	.056/14.0	.057/14.0
	19	.034/39.3	.034/39.3	.032/39.3	.030/34.9	.029/34.9	.029/34.9	.031/20.6	.035/20.3	.040/15.7	.045/15.7	.049/15.7	.052/15.7	.053/15.7
	21	.032/39.3	.031/39.3	.030/39.3	.028/39.3	.026/34.9	.026/34.9	.029/34.9	.032/20.3	.036/15.7	.041/15.7	.045/15.7	.047/15.7	.048/15.7

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 7 - RMS HEAVE IN SHORT-CRESTED SEAS

CSGN - CONVENTIONAL HULL

SHORTCRESTED
RMS VER DISP IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	0	15	30	45	60	75	90	105	120	135	150	165	180
		SHIP HEADING ANGLE IN DEGREES												
0	7	.027/ 8.1	.038/ 7.9	.060/ 7.9	.082/ 7.5	.099/ 7.3	.111/ 7.3	.115/ 7.3	.113/ 7.3	.103/ 7.3	.080/ 7.3	.068/ 7.5	.047/ 7.9	.037/ 7.9
	9	.053/11.2	.064/11.2	.088/10.5	.113/ 9.8	.134/ 9.5	.148/ 9.5	.153/ 9.5	.150/ 9.5	.137/ 9.5	.118/ 9.5	.096/10.5	.078/10.8	.059/11.2
	11	.093/12.6	.099/12.6	.119/12.6	.143/12.1	.163/12.1	.177/11.6	.192/11.6	.178/11.6	.165/12.1	.145/12.1	.122/12.6	.102/12.6	.093/12.6
	13	.129/14.0	.134/14.0	.158/14.0	.178/14.0	.187/14.0	.199/14.0	.204/14.0	.208/14.0	.188/14.0	.171/14.0	.152/14.0	.136/14.0	.129/14.0
	15	.159/15.7	.164/15.7	.176/15.7	.192/15.7	.206/15.7	.216/15.7	.219/15.7	.216/15.7	.206/15.7	.192/15.7	.177/15.7	.165/15.7	.160/15.7
	17	.181/18.0	.185/18.0	.194/18.0	.206/18.0	.218/18.0	.226/18.0	.229/18.0	.226/18.0	.218/18.0	.207/18.0	.195/18.0	.185/18.0	.182/18.0
	19	.198/20.9	.201/20.9	.208/18.0	.217/18.0	.226/18.0	.233/18.0	.235/18.0	.233/18.0	.227/18.0	.218/18.0	.208/18.0	.201/20.9	.198/20.9
	21	.211/20.9	.213/20.9	.219/20.9	.226/20.9	.233/20.9	.239/20.9	.240/20.9	.239/20.9	.234/20.9	.226/20.9	.219/20.9	.213/20.9	.211/20.9
5	7	.023/18.1	.036/ 8.3	.059/ 7.5	.081/ 7.5	.099/ 7.5	.112/ 7.5	.117/ 7.5	.115/ 7.5	.106/ 7.5	.091/ 7.5	.072/ 7.9	.052/ 7.9	.042/ 7.9
	9	.053/12.5	.061/12.1	.086/10.8	.112/10.5	.134/ 9.8	.149/ 9.5	.156/ 9.5	.153/ 9.5	.142/ 9.5	.123/ 9.5	.100/ 9.2	.070/ 9.8	.060/10.8
	11	.089/14.3	.097/14.3	.118/13.7	.142/13.1	.163/12.6	.177/12.1	.183/12.1	.188/12.1	.169/12.1	.150/12.1	.128/12.6	.109/12.6	.100/12.6
	13	.125/15.7	.132/15.7	.148/15.3	.168/15.0	.186/14.3	.199/14.0	.204/14.0	.201/14.0	.191/14.0	.174/14.0	.156/14.0	.140/14.0	.134/14.0
	15	.156/17.5	.161/17.5	.173/17.0	.189/16.5	.204/16.1	.215/15.7	.219/15.7	.217/15.7	.208/15.7	.195/15.7	.180/15.7	.168/15.7	.164/15.7
	17	.178/19.6	.182/19.0	.191/19.0	.204/18.5	.216/18.0	.225/18.0	.228/18.0	.227/18.0	.219/18.0	.209/18.0	.197/18.0	.188/18.0	.185/18.0
	19	.195/20.9	.198/20.3	.205/20.3	.215/19.6	.225/19.6	.232/19.0	.235/19.0	.233/18.5	.228/18.5	.219/18.0	.210/20.9	.203/20.9	.201/20.9
	21	.209/22.4	.211/22.4	.216/22.4	.224/21.7	.232/21.7	.237/20.9	.240/20.9	.239/20.9	.234/20.9	.228/20.9	.221/20.9	.216/20.9	.214/20.9
10	7	.022/12.9	.035/ 8.5	.050/ 8.1	.081/ 7.9	.100/ 7.5	.113/ 7.5	.119/ 7.5	.117/ 7.5	.108/ 7.9	.093/ 7.9	.074/ 7.9	.054/ 7.9	.044/ 8.3
	9	.049/14.0	.060/13.7	.085/11.2	.112/10.8	.135/10.5	.152/ 9.5	.159/ 9.5	.158/ 9.5	.144/ 9.5	.130/ 9.5	.108/ 9.5	.087/ 9.8	.077/10.9
	11	.086/16.5	.095/16.5	.116/16.1	.141/13.4	.163/12.6	.179/12.6	.186/12.1	.185/12.1	.174/12.1	.157/12.1	.136/12.6	.118/12.6	.110/12.6
	13	.127/18.0	.129/18.0	.146/17.5	.166/17.0	.185/15.7	.199/14.0	.206/14.0	.206/14.0	.195/14.0	.180/14.0	.163/14.0	.148/14.0	.143/14.0
	15	.153/19.6	.158/19.6	.171/19.0	.187/18.5	.203/17.5	.215/16.5	.220/15.7	.219/15.7	.212/15.7	.199/15.7	.186/15.7	.175/15.7	.170/15.7
	17	.175/20.9	.179/20.9	.189/20.3	.202/19.6	.214/19.0	.224/18.0	.229/18.0	.228/18.0	.222/18.0	.213/18.0	.202/18.0	.193/18.0	.190/18.0
	19	.192/22.4	.195/22.4	.202/21.7	.213/21.7	.223/20.9	.231/20.9	.235/20.3	.234/19.6	.230/19.0	.222/18.5	.214/20.9	.208/20.9	.205/20.9
	21	.205/24.2	.208/24.2	.214/24.2	.222/23.3	.230/22.4	.236/21.7	.240/20.9	.240/20.9	.236/20.9	.230/20.9	.224/20.9	.219/20.9	.217/20.9
15	7	.022/12.1	.035/ 9.0	.050/ 8.5	.081/ 7.9	.100/ 7.9	.113/ 7.9	.119/ 7.9	.118/ 7.9	.109/ 7.9	.094/ 7.9	.074/ 7.9	.053/ 8.3	.043/ 8.3
	9	.048/19.6	.059/19.6	.085/12.8	.112/10.5	.137/ 9.8	.154/ 9.5	.163/ 9.5	.163/ 9.5	.154/ 9.5	.137/ 9.5	.115/ 9.8	.095/10.5	.085/10.5
	11	.084/20.3	.093/20.3	.115/20.3	.140/13.4	.164/12.8	.181/12.6	.190/12.1	.191/12.1	.182/12.1	.167/11.6	.140/12.1	.131/12.1	.124/12.1
	13	.121/20.9	.126/20.9	.143/20.9	.165/20.3	.185/15.7	.200/14.0	.209/14.0	.209/14.0	.202/14.0	.189/14.0	.174/14.0	.160/14.0	.155/14.0
	15	.153/21.7	.155/21.7	.168/21.7	.185/21.7	.202/20.3	.215/17.0	.222/15.7	.223/15.7	.217/15.7	.207/15.7	.195/15.7	.185/15.7	.181/15.7
	17	.172/23.3	.175/23.3	.186/22.4	.199/22.4	.213/20.9	.224/19.6	.230/18.0	.231/18.0	.226/18.0	.218/18.0	.209/18.0	.201/18.0	.198/18.0
	19	.189/24.2	.192/24.2	.199/24.2	.210/23.3	.221/22.4	.230/20.9	.236/20.9	.236/20.9	.233/19.6	.227/19.0	.220/20.9	.214/20.9	.212/20.9
	21	.203/26.2	.205/26.2	.211/26.2	.220/25.1	.228/24.2	.236/23.3	.240/20.9	.241/20.9	.239/20.9	.234/20.9	.228/20.9	.224/20.9	.222/20.9
20	7	.021/16.8	.034/ 9.8	.050/ 9.5	.081/ 7.3	.100/ 7.5	.113/ 7.9	.119/ 7.9	.118/ 7.9	.109/ 7.9	.094/ 7.9	.073/ 7.9	.052/ 8.3	.041/ 8.5
	9	.046/19.0	.058/19.0	.084/19.0	.113/10.8	.138/10.5	.157/ 9.9	.167/ 9.5	.168/ 9.5	.160/ 9.5	.144/ 9.8	.123/10.5	.103 10.5	.094/10.5
	11	.082/23.3	.091/23.3	.113/23.3	.139/23.3	.164/12.1	.184/12.1	.195/11.6	.198/11.6	.192/11.6	.178/11.6	.161/11.6	.146/11.6	.140/11.6
	13	.117/26.2	.123/26.2	.141/26.2	.163/23.3	.185/15.7	.202/15.7	.213/14.0	.216/14.0	.211/14.0	.201/14.0	.188/14.0	.176/14.0	.172/14.0
	15	.146/26.2	.151/26.2	.165/26.2	.183/26.2	.201/23.3	.216/16.1	.225/15.7	.228/15.7	.226/15.7	.216/15.7	.206/15.7	.198/15.7	.195/15.7
	17	.164/27.3	.172/27.3	.183/27.3	.197/27.3	.212/23.1	.224/19.6	.232/18.0	.235/18.0	.232/18.0	.226/18.0	.218/18.0	.212/18.0	.210/18.0
	19	.185/27.3	.188/27.3	.197/27.3	.208/27.3	.220/28.2	.230/23.3	.237/20.9	.239/20.9	.238/20.3	.233/19.6	.227/19.6	.222/20.9	.220/20.9
	21	.203/28.6	.202/28.6	.209/28.6	.218/27.3	.227/27.3	.236/26.2	.241/23.3	.243/20.9	.242/20.9	.239/20.9	.234/20.9	.231/20.9	.229/20.9
25	7	.021/16.5	.034/16.5	.057/16.5	.080/16.5	.099/16.5	.112/ 7.9	.118/ 7.9	.117/ 7.9	.108/ 7.9	.092/ 7.9	.072/ 7.9	.050/ 8.3	.038/ 9.0
	9	.045/16.5	.057/16.5	.084/16.5	.113/16.5	.139/16.5	.158/10.9	.170/ 9.0	.172/ 9.8	.164/ 9.0	.149/10.5	.128/10.5	.109/10.6	.100/10.6
	11	.080/33.1	.089/33.1	.111/33.1	.139/17.5	.165/12.6	.186/12.1	.200/12.1	.205/11.6	.201/11.6	.190/11.6	.175/11.6	.161/11.6	.156/11.6
	13	.114/33.1	.121/33.1	.138/33.1	.162/33.1	.185/24.7	.204/14.0	.217/14.0	.223/14.0	.221/14.0	.213/14.0	.203/12.6	.194/12.6	.190/12.6
	15	.143/33.1	.149/33.1	.162/33.1	.181/33.1	.208/33.1	.217/18.0	.228/18.0	.234/15.7	.233/15.7	.228/15.7	.220/15.7	.213/15.7	.211/15.7
	17	.165/33.1	.169/33.1	.180/33.1	.199/33.1	.211/33.1	.225/18.5	.235/18.0	.240/18.0	.239/18.0	.236/18.0	.230/18.0	.225/18.0	.223/18.0
	19	.183/33.1	.186/33.1	.195/33.1	.206/33.1	.219/33.1	.231/26.2	.239/20.9	.243/20.9	.243/20.3	.241/20.3	.237/18.0	.233/20.9	.231/20.9
	21	.198/33.1	.200/33.1	.207/33.1	.216/33.1	.226/33.1	.236/26.2	.243/26.2	.244/20.9	.247/20.9	.245/20.9	.242/20.9	.239/20.9	.238/20.9
30	7	.021/28.3	.034/11.6	.056/11.6	.080/11.2	.099/ 7.9	.112/ 7.9	.117/ 7.9	.115/ 7.9	.108/ 7.9	.090/ 7.9	.070/ 7.9	.047/ 8.3	.039/ 9.0
	9	.046/28.3	.057/28.3	.083/28.3	.113/28.3	.139/28.3	.159/ 9.2	.171/ 9.2	.173/ 9.5	.166/ 9.5	.151/10.5	.130/10.8	.111/10.8	.102/11.2
	11	.074/28.6	.087/28.6	.110/28.3	.139/28.3	.166/28.3	.188/28.3	.204/12.1	.210/11.6	.208/11.6	.198/11.6	.185/11.6	.173/11.6	.168/12.1
	13	.112/36.9	.119/36.9	.137/36.9	.161/28.6	.185/28.6	.206/28.6	.221/14.0	.229/14.0	.230/14.0	.225/12.6	.217/12.6	.209/12.6	.206/12.6
	15	.142/36.9	.147/36.9	.161/36.9	.180/36.9	.208/36.9	.219/28.6	.232/15.7	.240/15.7	.242/15.7	.239/15.7	.234/15.7	.229/15.7	.227/15.7
	17	.164/36.9	.168/36.9	.179/36.9	.196/36.9	.211/36.9	.226/36.9	.238/28.3	.245/18.0	.247/18.0	.245/18.0	.242/18.0	.238/18.0	.237/18.0
	19	.181/39.3	.185/39.3	.193/39.3	.205/36.9	.219/36.9	.231/36.9	.241/28.0	.247/28.0	.250/28.0	.249/28.9	.247/18.0	.244/18.0	.243/18.0
	21	.196/39.3	.199/39.3	.207/39.3	.215/39.3	.226/36.9	.236/36.9	.245/28.6	.250/28.9	.252/28.9	.252/28.9	.250/28.9	.248/28.9	.248/28.9

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 8 - RMS ROLL IN SHORT-CRESTED SEAS

CGN - CONVENTIONAL HULL

SHORTCRESTED

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	0	15	30	45	60	75	90	105	120	135	150	165	180
		SHIP HEADING ANGLE IN DEGREES												
0	7	.031/ 9.5	.035/ 9.2	.042/ 9.0	.051/ 9.0	.060/ 9.0	.066/ 9.0	.069/ 9.0	.068/ 9.0	.064/ 9.0	.058/ 9.0	.049/ 9.0	.042/ 9.2	.039/ 9.2
	9	.096/11.2	.103/11.2	.118/11.2	.137/11.2	.156/11.2	.166/11.2	.172/11.2	.170/11.2	.161/11.2	.147/11.2	.132/11.2	.116/11.2	.118/11.2
	11	.157/11.6	.160/11.6	.180/11.6	.224/11.6	.227/11.6	.243/11.6	.253/11.6	.247/11.6	.235/11.6	.215/11.6	.193/11.6	.175/11.6	.168/11.6
	13	.163/11.6	.171/11.6	.191/11.6	.216/11.6	.239/11.6	.255/11.6	.267/11.6	.259/11.6	.246/11.6	.226/11.6	.204/11.6	.186/11.6	.179/11.6
	15	.152/12.1	.159/12.1	.177/11.6	.199/11.6	.220/11.6	.234/11.6	.243/11.6	.237/11.6	.228/11.6	.208/11.6	.188/11.6	.172/11.6	.165/11.6
	17	.134/12.1	.140/12.1	.156/12.1	.175/12.1	.192/12.1	.205/11.6	.218/11.6	.208/11.6	.197/11.6	.182/11.6	.166/11.6	.158/12.1	.145/12.1
	19	.115/12.1	.121/12.1	.134/12.1	.151/12.1	.166/12.1	.176/12.1	.181/12.1	.179/12.1	.170/12.1	.156/12.1	.141/12.1	.129/12.1	.125/12.1
	21	.099/12.1	.104/12.1	.115/12.1	.130/12.1	.142/12.1	.152/12.1	.155/12.1	.153/12.1	.146/12.1	.134/12.1	.121/12.1	.111/12.1	.107/12.1
5	7	.069/10.1	.062/10.1	.066/10.1	.071/10.1	.074/10.1	.075/ 9.0	.072/ 9.5	.066/ 9.2	.057/ 9.0	.047/ 9.0	.037/ 9.0	.029/ 9.0	.026/ 9.0
	9	.124/11.6	.129/11.6	.141/11.6	.153/11.2	.162/11.2	.164/11.2	.159/11.2	.147/11.2	.129/11.2	.109/11.2	.089/11.2	.074/11.6	.068/11.6
	11	.153/12.1	.160/11.6	.177/11.6	.196/11.6	.212/11.6	.219/11.6	.217/11.6	.206/11.6	.187/12.1	.164/12.1	.142/12.1	.126/12.6	.118/12.6
	13	.149/12.1	.156/12.1	.175/12.1	.196/12.1	.213/12.1	.224/12.1	.226/12.1	.218/12.1	.203/12.1	.183/12.6	.162/12.6	.145/12.6	.139/12.6
	15	.133/12.1	.140/12.1	.157/12.1	.177/12.1	.194/12.1	.205/12.1	.208/12.1	.204/12.6	.192/12.6	.175/12.6	.157/12.6	.143/12.6	.137/12.6
	17	.115/12.1	.121/12.1	.136/12.1	.153/12.1	.169/12.1	.179/12.1	.183/12.1	.180/12.6	.171/12.6	.157/12.6	.142/12.6	.130/12.6	.125/12.6
	19	.099/12.1	.103/12.1	.116/12.1	.132/12.1	.145/12.1	.155/12.1	.159/12.6	.157/12.6	.149/12.6	.137/12.6	.124/12.6	.114/12.6	.113/12.6
	21	.084/12.1	.089/12.1	.100/12.1	.113/12.1	.125/12.1	.133/12.1	.137/12.6	.136/12.6	.129/12.6	.119/12.6	.108/12.6	.100/12.6	.096/12.6
10	7	.127/12.1	.122/12.1	.123/12.1	.123/12.1	.120/12.1	.111/10.9	.097/10.0	.079/10.6	.060/10.5	.044/ 9.0	.031/ 9.0	.023/ 8.5	.019/ 8.5
	9	.149/12.1	.153/12.1	.163/12.1	.172/12.1	.177/12.1	.173/12.1	.160/11.2	.140/11.2	.115/11.2	.089/11.2	.067/11.2	.051/11.2	.046/11.2
	11	.146/12.1	.153/12.1	.170/12.1	.187/12.1	.198/12.1	.201/12.1	.194/12.1	.178/12.1	.155/12.1	.138/12.1	.106/12.6	.089/12.6	.083/12.6
	13	.137/12.1	.139/12.1	.157/12.1	.176/12.1	.191/12.1	.198/12.1	.196/12.1	.188/12.6	.169/12.6	.148/12.6	.128/12.6	.113/14.0	.108/14.0
	15	.114/12.6	.121/12.6	.137/12.6	.156/12.6	.171/12.6	.180/12.6	.181/12.6	.175/12.6	.163/12.6	.146/14.0	.130/14.0	.117/14.0	.112/14.0
	17	.097/12.6	.103/12.6	.118/12.6	.134/12.6	.148/12.6	.158/12.6	.161/12.6	.157/12.6	.148/12.0	.134/14.0	.121/14.0	.110/14.0	.106/14.0
	19	.083/12.6	.088/12.6	.100/12.6	.115/12.6	.128/12.6	.136/12.6	.140/12.6	.138/12.6	.130/14.0	.120/14.0	.108/14.0	.099/14.0	.096/14.0
	21	.071/12.6	.075/12.6	.086/12.6	.099/12.6	.110/12.6	.118/12.0	.121/12.6	.120/12.0	.116/14.0	.105/14.0	.095/14.0	.088/14.0	.085/14.0
15	7	.091/10.1	.096/10.1	.109/10.1	.120/10.1	.125/10.1	.122/10.1	.117/10.1	.095/10.1	.073/10.1	.049/10.1	.030/ 9.2	.019/ 8.5	.016/ 8.5
	9	.113/14.3	.122/12.1	.143/12.1	.163/12.1	.173/12.1	.174/12.1	.164/12.1	.145/12.1	.117/12.1	.087/11.2	.059/11.2	.042/11.2	.036/11.2
	11	.114/14.3	.125/12.6	.149/12.6	.172/12.6	.188/12.6	.193/12.1	.187/12.1	.171/12.1	.147/12.1	.119/12.1	.091/12.6	.073/12.6	.066/12.6
	13	.104/14.3	.114/12.6	.137/12.6	.161/12.6	.178/12.6	.187/12.6	.186/12.6	.178/12.6	.158/12.6	.139/12.6	.112/14.0	.096/14.0	.089/14.0
	15	.091/14.3	.100/14.3	.120/12.6	.142/12.6	.159/12.6	.169/12.6	.177/12.6	.166/12.6	.153/12.8	.135/14.0	.116/14.0	.103/14.0	.098/14.0
	17	.079/17.5	.086/14.3	.103/12.6	.122/12.6	.138/12.6	.149/12.6	.157/12.0	.149/13.1	.140/14.0	.126/14.0	.111/14.0	.099/14.0	.095/15.7
	19	.067/17.5	.076/17.5	.089/12.0	.105/12.6	.119/12.6	.129/12.9	.133/12.0	.132/14.0	.124/14.0	.113/14.0	.101/14.0	.091/15.7	.088/15.7
	21	.059/17.5	.063/17.5	.076/12.0	.091/12.0	.103/12.0	.112/12.0	.116/13.1	.115/14.0	.109/14.0	.100/14.0	.090/15.7	.082/15.7	.079/15.7
20	7	.074/13.4	.086/13.4	.104/13.4	.119/13.4	.127/13.4	.126/13.4	.118/13.4	.102/13.4	.088/13.4	.056/13.4	.038/10.1	.016/ 8.5	.013/ 8.5
	9	.092/13.4	.104/13.4	.130/13.4	.152/13.4	.165/13.4	.168/13.4	.161/13.4	.143/13.4	.117/13.4	.086/11.2	.055/11.2	.035/10.0	.029/11.2
	11	.092/13.4	.106/13.4	.133/13.4	.156/13.4	.174/13.4	.181/13.4	.176/13.4	.162/13.4	.138/11.6	.109/11.6	.088/12.1	.060/12.6	.053/14.0
	13	.085/19.0	.097/13.4	.122/13.4	.146/13.4	.164/13.4	.173/13.4	.173/13.4	.163/13.4	.146/13.4	.122/13.4	.098/14.0	.080/14.0	.074/14.0
	15	.075/19.0	.086/19.0	.107/13.4	.129/13.4	.147/13.4	.157/13.4	.163/13.4	.156/13.4	.141/14.0	.123/14.0	.104/14.0	.089/15.7	.084/15.7
	17	.066/23.3	.076/19.0	.093/13.4	.112/13.4	.128/13.4	.138/13.4	.142/13.4	.140/14.0	.130/14.0	.116/14.0	.101/15.7	.089/15.7	.085/15.7
	19	.057/23.3	.066/23.3	.080/14.3	.096/13.4	.111/13.4	.121/13.4	.125/14.0	.126/14.0	.117/14.3	.108/15.7	.096/15.7	.086/15.7	.080/15.7
	21	.049/23.3	.055/23.3	.069/19.0	.083/13.4	.096/13.4	.105/14.0	.109/14.0	.109/14.3	.104/15.7	.095/15.7	.085/15.7	.077/15.7	.074/15.7
25	7	.059/16.5	.071/16.5	.091/16.5	.108/16.5	.119/16.5	.122/16.5	.116/16.5	.104/16.5	.085/10.0	.063/10.0	.036/10.0	.014/ 8.5	.011/ 9.0
	9	.076/16.5	.092/16.5	.122/16.5	.146/16.5	.162/16.5	.167/16.5	.161/16.5	.144/16.5	.121/11.2	.089/11.2	.055/11.2	.030/10.0	.024/10.0
	11	.079/16.5	.095/16.5	.124/16.5	.150/16.5	.168/16.5	.176/16.5	.172/16.5	.159/12.1	.136/12.1	.106/12.1	.074/12.1	.051/12.6	.046/14.0
	13	.074/16.5	.088/16.5	.114/16.5	.139/16.5	.157/16.5	.167/16.5	.167/16.5	.157/12.1	.139/12.1	.115/12.6	.089/14.0	.071/14.0	.063/15.7
	15	.066/16.5	.077/16.5	.100/16.5	.122/16.5	.140/16.5	.151/16.5	.153/16.5	.148/12.6	.135/12.6	.116/14.0	.096/15.7	.081/15.7	.075/15.7
	17	.058/16.5	.067/16.5	.087/16.5	.106/16.5	.122/16.5	.133/16.5	.137/16.5	.134/16.5	.125/16.5	.111/15.7	.096/15.7	.084/15.7	.079/15.7
	19	.051/16.5	.058/16.5	.075/16.5	.092/16.5	.106/16.5	.116/16.5	.121/16.5	.120/16.5	.113/16.5	.102/15.7	.090/15.7	.081/15.7	.077/15.7
	21	.044/16.5	.051/16.5	.065/16.5	.079/16.5	.092/16.5	.101/16.5	.106/16.5	.106/16.5	.101/16.5	.092/15.7	.082/15.7	.075/15.7	.072/15.7
30	7	.096/11.2	.122/11.2	.165/11.2	.199/11.2	.221/11.2	.228/11.2	.219/11.2	.194/11.2	.160/11.2	.114/11.2	.061/11.2	.014/ 8.5	.010/ 9.0
	9	.107/11.6	.136/11.6	.187/11.6	.227/11.6	.253/11.6	.263/11.6	.254/11.6	.229/11.6	.189/11.6	.137/11.6	.079/11.6	.031/11.2	.023/10.0
	11	.097/11.6	.125/11.6	.171/11.6	.210/11.6	.237/11.6	.249/11.6	.244/11.6	.224/11.6	.190/11.6	.145/11.6	.095/11.6	.057/12.6	.046/14.0
	13	.085/20.3	.107/11.6	.140/11.6	.177/11.6	.210/11.6	.224/11.6	.225/11.6	.212/11.6	.187/12.1	.152/12.1	.113/12.1	.083/15.7	.072/15.7
	15	.071/20.3	.091/12.1	.125/12.1	.157/12.1	.182/12.1	.198/12.1	.202/12.1	.196/12.1	.178/12.1	.153/12.1	.124/15.7	.101/15.7	.096/15.7
	17	.063/20.6	.077/20.6	.106/12.1	.133/12.1	.156/12.1	.172/12.1	.179/12.1	.177/12.1	.165/12.1	.147/15.7	.125/15.7	.109/15.7	.103/15.7
	19	.054/20.6	.066/20.6	.089/12.1	.113/12.1	.134/12.1	.149/12.1	.157/12.1	.157/12.1	.149/15.7	.135/15.7	.119/15.7	.107/15.7	.102/16.0
	21	.047/20.6	.057/20.6	.076/12.1	.097/12.1	.115/12.1	.128/12.1	.136/12.1	.130/12.1	.133/15.7	.122/15.7	.110/15.7	.099/16.0	.096/16.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 9 - RMS VERTICAL ACCELERATION AT THE PILOTHOUSE IN SHORT-CRESTED SEAS

CSGN - CONVENTIONAL HULL

SHORTCRESTED
RMS VER ACC IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS
(ACC. X 100)
PILOT HOUSE (STATION 8) - 399.6 FT FROM AP, 18.0 FT OFF CL, AND 98.0 FT ABOVE BL

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.37?/ 7.5	.102/ 7.0	.164/ 6.7	.238/ 6.7	.205/ 6.7	.326/ 6.7	.363/ 6.7	.361/ 6.7	.319/ 6.7	.278/ 6.7	.223/ 7.0	.167/ 7.0	.139/ 7.3
	9	.349/ 7.9	.113/ 7.9	.167/ 7.5	.226/ 7.3	.277/ 7.3	.316/ 7.0	.333/ 7.0	.332/ 7.0	.312/ 7.3	.276/ 7.3	.227/ 7.5	.179/ 7.5	.155/ 7.9
	11	.107/12.1	.120/12.1	.150/12.1	.202/ 7.9	.242/ 7.9	.272/ 7.9	.287/ 7.9	.287/ 7.9	.271/ 7.9	.242/ 9.2	.205/10.5	.169/10.5	.153/10.5
	13	.115/12.6	.125/12.6	.150/12.6	.181/12.6	.210/12.6	.232/ 9.2	.243/ 9.2	.242/ 9.5	.230/10.5	.208/10.5	.180/10.8	.154/10.8	.143/10.8
	15	.116/14.0	.122/14.0	.140/12.6	.162/12.6	.183/12.6	.199/12.6	.207/12.6	.208/10.5	.196/10.5	.179/10.5	.150/10.8	.139/10.8	.131/14.0
	17	.111/14.3	.116/14.0	.128/14.0	.145/14.0	.160/14.0	.172/14.0	.178/14.0	.177/14.0	.169/14.0	.155/14.0	.139/14.0	.125/15.7	.120/15.7
	19	.104/15.7	.107/15.7	.116/14.0	.129/14.0	.141/14.0	.150/14.0	.154/14.0	.153/14.0	.146/15.7	.136/15.7	.123/15.7	.113/15.7	.108/15.7
	21	.395/15.7	.098/15.7	.105/15.7	.115/15.7	.124/15.7	.131/15.7	.135/15.7	.133/15.7	.128/15.7	.120/15.7	.110/15.7	.102/15.7	.098/15.7
5	7	.043/ 7.8	.087/ 7.0	.156/ 6.7	.226/ 6.7	.286/ 6.7	.331/ 6.8	.355/ 7.0	.357/ 7.0	.338/ 7.0	.308/ 7.0	.260/ 7.3	.194/ 7.5	.167/ 7.5
	9	.365/12.6	.094/12.6	.154/ 7.1	.220/ 7.3	.279/ 7.3	.325/ 7.3	.352/ 7.5	.359/ 7.5	.346/ 7.5	.316/ 7.9	.273/ 7.9	.230/ 7.9	.209/ 7.9
	11	.084/13.1	.102/13.1	.144/12.8	.195/ 7.9	.244/ 7.9	.282/ 7.9	.307/ 7.9	.315/ 7.9	.308/ 7.9	.286/ 7.9	.256/ 9.8	.226/10.5	.213/10.5
	13	.394/14.0	.105/13.7	.134/13.4	.172/13.1	.209/12.8	.240/ 8.5	.260/ 9.0	.268/ 9.5	.264/ 9.0	.249/10.5	.228/10.8	.208/11.2	.199/11.6
	15	.395/15.0	.103/14.6	.124/14.3	.152/14.0	.188/13.7	.206/13.1	.220/12.0	.227/10.5	.225/10.8	.215/11.2	.200/11.6	.186/11.6	.180/12.1
	17	.392/15.7	.097/15.7	.113/15.3	.134/15.0	.156/14.3	.175/14.0	.190/14.0	.194/13.4	.193/11.6	.186/11.6	.175/12.1	.165/12.1	.161/12.1
	19	.346/17.0	.090/17.0	.102/16.1	.119/15.7	.136/15.7	.152/15.3	.162/15.3	.167/15.7	.167/15.7	.161/15.7	.154/15.7	.146/15.7	.143/15.7
	21	.379/17.5	.082/17.5	.092/17.5	.105/17.0	.120/16.1	.132/15.7	.141/15.7	.145/15.7	.145/15.7	.141/15.7	.135/15.7	.130/15.7	.127/15.7
10	7	.363/12.1	.082/ 7.0	.152/ 7.0	.225/ 7.0	.289/ 7.0	.337/ 7.0	.365/ 7.0	.370/ 7.0	.353/ 7.0	.316/ 7.3	.263/ 7.5	.200/ 7.9	.181/ 7.9
	9	.057/12.6	.086/12.6	.149/ 7.3	.221/ 7.5	.287/ 7.5	.341/ 7.7	.377/ 7.9	.391/ 7.9	.385/ 7.9	.359/ 8.3	.320/ 8.3	.279/ 8.5	.261/ 9.5
	11	.077/15.3	.089/15.3	.136/12.8	.196/ 7.9	.251/ 7.9	.300/ 8.1	.334/ 8.3	.353/ 8.5	.354/ 9.0	.340/ 9.5	.319/ 9.8	.290/10.5	.279/10.5
	13	.076/16.1	.089/16.1	.123/15.3	.160/13.4	.214/ 8.3	.254/ 8.5	.284/ 9.0	.302/ 9.5	.307/ 9.8	.301/10.5	.287/10.8	.271/10.8	.269/10.8
	15	.377/17.8	.086/17.0	.111/16.5	.146/15.0	.187/14.0	.215/ 9.8	.240/ 9.5	.257/10.5	.263/10.5	.261/11.2	.253/11.2	.243/11.6	.239/11.6
	17	.374/18.0	.081/18.0	.108/17.5	.127/16.5	.156/15.7	.183/14.0	.204/12.8	.219/12.1	.225/11.6	.225/11.6	.220/12.1	.214/12.6	.211/12.6
	19	.369/19.8	.075/19.8	.096/18.5	.111/17.5	.135/16.1	.157/13.7	.175/15.8	.188/12.8	.194/12.6	.195/12.6	.192/12.6	.188/12.6	.186/12.6
	21	.365/19.6	.069/19.6	.081/19.6	.098/18.5	.118/17.5	.136/16.9	.152/15.7	.162/15.7	.168/15.7	.170/12.6	.168/12.6	.166/12.6	.164/12.6
15	7	.034/ 8.1	.076/ 7.3	.148/ 7.8	.223/ 7.8	.290/ 7.1	.341/ 7.3	.371/ 7.3	.379/ 7.3	.363/ 7.3	.327/ 7.5	.276/ 7.5	.218/ 7.9	.190/ 8.3
	9	.344/12.8	.078/ 7.9	.144/ 7.5	.222/ 7.9	.297/ 7.9	.359/ 7.9	.403/ 7.9	.426/ 8.3	.426/ 8.5	.405/ 8.9	.369/ 9.5	.331/ 9.5	.314/ 9.8
	11	.355/15.7	.076/13.1	.129/ 7.9	.195/ 7.9	.262/ 8.3	.321/ 8.5	.367/ 9.0	.397/ 9.2	.408/ 9.5	.403/ 9.8	.386/10.5	.366/10.5	.357/10.5
	13	.353/20.3	.074/20.3	.114/13.4	.166/ 8.3	.222/ 9.0	.273/ 9.0	.316/ 9.5	.346/ 9.8	.362/10.5	.365/10.5	.359/10.8	.350/10.8	.345/10.8
	15	.069/20.3	.071/20.3	.101/20.3	.142/14.0	.188/ 9.0	.231/ 9.2	.267/ 9.8	.295/10.5	.312/10.5	.319/10.8	.318/11.2	.314/11.2	.312/11.2
	17	.358/20.9	.066/20.9	.090/20.3	.123/15.7	.160/15.3	.195/ 9.9	.227/10.5	.251/10.5	.267/10.8	.275/11.2	.277/11.2	.276/11.6	.275/11.6
	19	.357/21.7	.062/21.7	.080/20.9	.107/20.3	.137/15.7	.167/15.7	.193/10.5	.219/10.8	.229/11.2	.238/11.6	.241/11.6	.241/11.6	.240/11.6
	21	.352/22.4	.057/22.4	.072/21.7	.094/20.9	.119/18.0	.144/15.7	.167/15.7	.189/12.6	.198/11.6	.206/11.6	.210/12.1	.210/12.1	.210/12.1
20	7	.327/13.4	.071/ 6.3	.144/ 6.5	.221/ 7.8	.289/ 7.8	.342/ 7.3	.374/ 7.3	.382/ 7.5	.367/ 7.5	.331/ 7.5	.278/ 7.9	.221/ 8.3	.193/ 8.3
	9	.036/16.3	.071/16.3	.141/ 7.5	.224/ 7.9	.306/ 7.9	.376/ 8.3	.428/ 8.5	.457/ 8.5	.463/ 9.0	.446/ 9.2	.413/ 9.8	.378/10.5	.361/10.5
	11	.343/19.8	.067/16.6	.124/ 7.9	.197/ 8.3	.274/ 8.5	.344/ 9.0	.407/ 9.2	.443/ 9.5	.465/10.5	.469/10.5	.460/10.5	.446/10.8	.439/10.8
	13	.346/23.3	.063/23.3	.108/14.6	.167/ 8.5	.233/ 9.8	.296/ 9.5	.350/ 9.8	.393/10.5	.422/10.5	.436/10.8	.439/10.8	.436/10.8	.434/11.2
	15	.347/23.3	.059/23.3	.096/15.3	.142/ 9.0	.196/ 9.2	.250/ 9.5	.298/10.5	.338/10.5	.367/10.8	.384/11.2	.393/11.2	.395/11.2	.395/11.2
	17	.346/26.2	.055/26.2	.082/23.3	.121/15.3	.166/ 9.5	.211/ 9.8	.253/10.5	.288/10.8	.315/10.8	.333/11.2	.343/11.2	.347/11.6	.348/11.6
	19	.344/26.2	.051/26.2	.073/26.2	.105/15.7	.142/15.7	.180/10.5	.215/10.5	.246/10.8	.270/11.2	.287/11.2	.297/11.6	.302/11.6	.303/11.6
	21	.342/27.3	.048/27.3	.065/27.3	.091/19.8	.123/15.7	.155/10.5	.185/10.5	.212/10.8	.233/11.2	.248/11.6	.258/11.6	.262/11.6	.264/11.6
25	7	.022/16.5	.060/ 6.3	.142/ 6.3	.219/ 6.7	.289/ 7.3	.342/ 7.9	.376/ 7.9	.383/ 7.9	.368/ 7.9	.331/ 7.9	.277/ 7.9	.218/ 8.3	.189/ 8.5
	9	.329/16.5	.066/16.5	.140/ 7.9	.226/ 7.9	.316/ 7.9	.392/ 8.3	.450/ 9.0	.484/ 9.0	.493/ 9.8	.478/ 9.5	.448/10.5	.413/10.5	.397/10.5
	11	.033/16.5	.061/16.5	.122/ 7.9	.202/ 8.3	.288/ 9.0	.368/ 9.2	.437/ 9.5	.489/10.5	.520/10.5	.532/10.8	.530/10.8	.520/10.8	.515/10.8
	13	.036/16.5	.055/16.5	.105/16.5	.171/ 9.0	.246/ 9.2	.320/ 9.5	.387/10.5	.442/10.5	.483/10.8	.508/11.2	.520/11.2	.524/11.2	.524/11.2
	15	.034/33.1	.051/16.5	.090/16.5	.144/ 9.0	.207/ 9.5	.271/10.5	.331/10.5	.383/10.8	.424/11.2	.453/11.2	.471/11.6	.479/11.6	.482/11.6
	17	.034/33.1	.047/33.1	.078/16.5	.123/16.5	.175/ 9.5	.229/10.5	.287/10.8	.328/11.2	.366/11.2	.394/11.6	.412/11.6	.422/11.6	.425/11.6
	19	.035/33.1	.043/33.1	.068/33.1	.105/16.5	.149/ 9.8	.195/10.5	.240/10.8	.280/11.2	.314/11.6	.340/11.6	.356/11.6	.367/11.6	.370/11.6
	21	.033/33.1	.040/33.1	.061/33.1	.091/18.8	.128/16.5	.167/10.5	.206/10.8	.241/11.2	.271/11.6	.294/11.6	.310/11.6	.319/11.6	.322/12.1
30	7	.323/11.6	.060/ 6.3	.141/ 6.3	.228/ 6.5	.289/ 7.5	.342/ 7.9	.376/ 7.9	.382/ 7.9	.367/ 7.9	.329/ 7.9	.276/ 7.9	.213/ 8.3	.182/ 8.8
	9	.327/12.1	.066/12.1	.142/ 7.9	.234/ 7.9	.327/ 8.3	.407/ 8.5	.469/ 9.0	.506/ 9.2	.517/ 9.2	.503/ 9.5	.471/10.5	.438/10.8	.418/10.8
	11	.033/20.3	.059/20.3	.124/ 8.3	.218/ 8.5	.303/ 9.2	.393/ 9.5	.471/ 9.8	.531/10.5	.570/10.8	.588/11.2	.590/11.2	.583/11.2	.579/11.2
	13	.332/20.3	.052/20.3	.105/12.6	.178/ 9.0	.261/ 9.5	.346/10.5	.426/10.5	.491/10.8	.543/11.2	.578/11.6	.597/11.6	.606/11.6	.608/11.6
	15	.331/20.6	.046/20.3	.089/12.0	.149/ 9.2	.220/ 9.8	.295/10.5	.366/10.8	.430/11.2	.483/11.6	.522/11.6	.548/11.6	.562/11.6	.566/12.1
	17	.329/34.9	.042/34.9	.076/20.3	.126/ 9.2	.186/ 9.8	.249/10.5	.312/10.8	.370/11.4	.419/11.8	.457/11.6	.483/12.1	.498/12.1	.503/12.1
	19	.329/34.9	.038/34.9	.066/20.3	.108/12.0	.158/10.5	.212/10.5	.266/11.2	.317/11.6	.360/11.6	.395/12.1	.419/12.1	.434/12.1	.439/12.1
	21	.327/34.9	.035/34.9	.059/34.9	.093/20.3	.135/10.5	.182/10.5	.228/11.2	.272/11.6	.311/12.1	.341/12.1	.364/12.1	.377/12.1	.381/12.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 10 - RMS VERTICAL DISPLACEMENT AT STATION 15 MAIN DECK IN SHORT-CRESTED SEAS

CSGN - CONVENTIONAL HULL

SHORTCRESTED

RMS VER DISP IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

STATION 15 - 166.5 FT FROM AP AND 51.5 FT ABOVE BL

V	T_0	0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	[illegible]/ 7.9	.069/ 7.9	.080/ 7.9	.107/ 7.5	.124/ 7.5	.134/ 7.5	.136/ 7.5	.131/ 7.5	.119/ 7.5	.101/ 7.5	.080/ 7.9	.061/ 7.9	.053/ 7.9
	9	[illegible]/10.5	.118/10.5	.129/10.5	.150/ 9.8	.168/ 9.5	.179/ 9.5	.182/ 9.5	.177/ 9.5	.167/ 9.5	.144/10.1	.122/10.5	.104/10.5	.096/10.8
	11	.148/12.1	.156/12.1	.167/12.1	.184/11.6	.199/11.6	.209/11.6	.217/11.6	.208/11.6	.196/11.6	.180/12.1	.163/12.1	.149/12.1	.144/12.1
	13	.184/14.0	.187/14.0	.197/14.0	.213/14.0	.221/14.0	.229/12.6	.231/12.6	.228/12.6	.219/14.0	.207/14.0	.196/14.0	.185/14.0	.181/14.0
	15	.208/15.7	.211/15.7	.218/15.7	.227/15.7	.235/15.7	.241/15.7	.243/15.7	.248/15.7	.234/15.7	.225/15.7	.216/15.7	.209/15.7	.207/15.7
	17	.223/18.0	.225/18.0	.230/18.0	.236/18.0	.243/18.0	.247/18.0	.248/18.0	.246/18.0	.242/18.0	.235/18.0	.229/18.0	.224/18.0	.222/18.0
	19	.232/18.0	.234/18.0	.237/18.0	.242/18.0	.247/18.0	.250/18.0	.251/18.0	.250/18.0	.246/18.0	.242/18.0	.237/18.0	.233/18.0	.232/18.0
	21	.240/20.9	.241/20.9	.243/20.9	.247/20.9	.251/20.9	.253/20.9	.254/20.9	.253/20.9	.253/20.9	.247/20.9	.243/20.9	.240/20.9	.239/20.9
5	7	.057/ 9.5	.061/ 9.2	.080/ 8.3	.100/ 7.9	.116/ 7.9	.126/ 7.9	.129/ 7.9	.125/ 7.5	.114/ 7.5	.097/ 7.9	.077/ 7.9	.059/ 7.9	.051/ 7.9
	9	.091/12.1	.099/12.1	.117/11.6	.139/10.5	.157/10.5	.169/ 9.8	.173/ 9.8	.169/ 9.5	.156/ 9.8	.130/ 9.8	.110/10.5	.100/10.5	.093/10.5
	11	.135/13.7	.143/13.7	.155/13.6	.173/13.1	.189/12.6	.199/12.1	.203/12.1	.199/11.6	.189/12.1	.173/12.1	.157/12.1	.143/12.6	.138/12.6
	13	.172/15.3	.174/15.3	.185/15.0	.198/14.6	.211/14.0	.220/14.0	.223/14.0	.220/14.0	.212/14.0	.200/14.0	.188/14.0	.178/14.0	.174/14.0
	15	.196/17.0	.199/17.0	.206/17.0	.216/16.1	.226/15.7	.233/15.7	.236/15.7	.234/15.7	.228/15.7	.219/15.7	.210/15.7	.203/15.7	.201/15.7
	17	.212/19.0	.214/19.0	.220/18.5	.227/18.0	.234/18.0	.240/18.0	.242/18.0	.241/18.0	.236/18.0	.230/18.0	.224/18.0	.219/18.0	.217/18.0
	19	.223/19.6	.224/19.6	.229/19.6	.234/19.6	.240/19.6	.244/19.0	.246/18.5	.245/18.5	.242/18.0	.237/18.0	.232/18.0	.229/18.0	.228/18.0
	21	.231/22.4	.233/22.4	.236/22.4	.240/21.7	.244/21.7	.247/20.9	.249/20.9	.248/20.9	.246/20.9	.243/20.9	.239/20.9	.237/20.9	.236/20.9
10	7	.045/12.0	.054/12.0	.073/ 8.3	.093/ 7.9	.110/ 7.9	.120/ 7.9	.124/ 7.9	.120/ 7.9	.110/ 7.9	.094/ 7.9	.075/ 7.9	.057/ 7.9	.048/ 7.9
	9	.082/15.0	.098/13.7	.109/13.6	.131/11.6	.150/10.5	.162/10.5	.167/10.1	.163/ 9.8	.151/ 9.8	.134/ 9.8	.113/10.5	.095/10.5	.088/10.8
	11	.124/18.1	.130/18.1	.145/15.7	.164/15.3	.180/13.6	.192/12.6	.196/12.1	.193/12.1	.183/12.1	.167/12.1	.150/12.1	.136/12.6	.130/12.6
	13	.159/17.5	.163/17.5	.175/17.0	.189/16.5	.203/15.7	.212/14.6	.216/14.0	.214/14.0	.206/14.0	.194/14.0	.181/14.0	.171/14.0	.167/14.0
	15	.185/19.3	.188/19.5	.197/18.5	.208/18.0	.218/17.5	.226/16.9	.229/15.7	.228/15.7	.222/15.7	.213/15.7	.204/15.7	.198/15.7	.194/15.7
	17	.203/20.3	.205/20.3	.211/19.6	.219/19.6	.227/19.0	.234/18.9	.236/18.0	.236/18.0	.231/18.0	.225/18.0	.218/18.0	.213/18.0	.211/18.0
	19	.214/21.7	.216/21.7	.221/21.7	.227/21.7	.234/20.9	.238/20.9	.241/19.6	.240/19.0	.237/18.0	.233/18.0	.228/18.0	.224/18.0	.222/18.0
	21	.224/24.2	.225/24.2	.229/24.2	.234/23.3	.239/22.4	.243/21.7	.245/20.9	.244/20.9	.242/20.9	.239/20.9	.235/20.9	.232/20.9	.231/20.9
15	7	.039/17.5	.049/17.5	.068/ 8.5	.089/ 8.1	.105/ 7.9	.116/ 7.9	.120/ 7.9	.117/ 7.9	.107/ 7.9	.091/ 7.9	.071/ 7.9	.052/ 7.9	.043/ 7.9
	9	.074/19.6	.082/19.6	.102/17.5	.125/12.1	.145/10.5	.158/10.1	.163/10.1	.160/ 9.5	.149/ 9.8	.131/ 9.8	.110/10.5	.090/10.5	.081/10.8
	11	.117/20.3	.121/20.3	.137/20.3	.156/20.3	.174/12.8	.187/12.6	.192/12.6	.189/12.1	.179/12.1	.163/12.1	.145/12.1	.130/12.6	.124/12.6
	13	.149/20.3	.154/20.3	.166/20.3	.181/20.3	.196/15.7	.207/15.3	.212/14.0	.210/14.0	.202/14.0	.189/14.0	.175/14.0	.164/14.0	.160/14.0
	15	.176/21.7	.179/21.7	.188/21.7	.200/20.9	.212/20.3	.220/17.9	.225/15.7	.224/15.7	.218/15.7	.209/15.7	.198/15.7	.190/15.7	.187/15.7
	17	.194/22.4	.196/22.4	.203/22.4	.212/21.7	.221/20.9	.228/20.3	.232/18.0	.232/18.0	.227/18.0	.221/18.0	.213/18.0	.208/18.0	.205/18.0
	19	.207/24.2	.208/24.2	.214/24.2	.221/23.3	.228/22.4	.234/20.9	.237/20.9	.237/20.3	.234/19.0	.229/18.0	.224/18.0	.219/18.0	.218/18.0
	21	.217/26.2	.219/26.2	.222/25.1	.229/25.1	.234/24.2	.238/22.4	.241/20.9	.241/20.9	.239/20.9	.235/20.9	.232/20.9	.229/20.9	.227/20.9
20	7	.034/13.4	.045/13.4	.065/13.4	.085/13.4	.102/ 7.9	.113/ 7.9	.117/ 7.9	.115/ 7.9	.105/ 7.9	.089/ 7.9	.069/ 7.9	.050/ 8.3	.039/ 8.3
	9	.063/23.3	.077/23.3	.097/19.0	.121/19.0	.141/19.0	.156/10.5	.163/ 9.8	.160/ 9.5	.150/ 9.5	.133/ 9.5	.111/ 9.8	.091/10.5	.082/10.5
	11	.107/23.3	.114/23.3	.130/23.3	.151/23.3	.170/23.3	.184/12.1	.191/12.1	.189/12.1	.180/12.1	.165/12.1	.147/12.1	.131/12.6	.125/12.6
	13	.141/26.2	.146/26.2	.158/23.3	.175/23.3	.191/23.3	.203/15.7	.209/14.0	.208/14.0	.201/14.0	.189/14.0	.175/14.0	.164/14.0	.159/14.0
	15	.167/26.2	.171/26.2	.180/26.2	.193/26.2	.206/23.3	.216/19.0	.221/15.7	.221/15.7	.216/15.7	.207/15.7	.197/15.7	.189/15.7	.186/15.7
	17	.186/27.3	.188/27.3	.196/27.3	.205/26.2	.216/23.3	.224/23.3	.229/19.0	.229/18.0	.225/18.0	.219/18.0	.212/18.0	.206/18.0	.203/18.0
	19	.199/27.3	.201/27.3	.207/27.3	.215/27.3	.223/26.2	.229/23.3	.233/20.9	.234/20.9	.232/20.3	.227/18.0	.222/18.0	.217/20.9	.216/20.9
	21	.211/27.3	.212/27.3	.217/27.3	.223/27.3	.229/27.3	.234/26.2	.238/23.3	.238/20.9	.237/20.9	.233/20.9	.230/20.9	.226/20.9	.225/20.9
25	7	.034/16.5	.043/16.5	.063/16.5	.083/16.5	.100/16.5	.111/16.5	.116/16.5	.113/16.5	.104/ 7.9	.088/ 7.9	.068/ 7.9	.048/ 8.3	.038/ 9.0
	9	.065/16.5	.073/16.5	.094/16.5	.118/16.5	.139/16.5	.155/16.5	.163/16.5	.163/16.5	.154/ 9.8	.137/ 9.8	.117/10.5	.098/10.5	.089/10.5
	11	.107/33.1	.108/33.1	.125/33.1	.146/16.5	.167/16.5	.183/16.5	.191/16.5	.192/12.1	.185/11.6	.172/11.6	.155/11.6	.141/11.6	.135/11.6
	13	.136/33.1	.139/33.1	.152/33.1	.169/33.1	.186/24.2	.200/16.5	.209/16.5	.210/14.0	.205/14.0	.195/14.0	.182/14.0	.172/14.0	.168/14.0
	15	.160/33.1	.164/33.1	.174/33.1	.187/33.1	.201/33.1	.213/16.5	.222/16.5	.222/16.5	.218/15.7	.211/15.7	.202/15.7	.196/15.7	.191/15.7
	17	.179/33.1	.182/33.1	.189/33.1	.200/33.1	.211/33.1	.220/24.2	.227/18.0	.229/18.0	.226/18.0	.221/18.0	.214/18.0	.209/18.0	.207/18.0
	19	.193/33.1	.195/33.1	.201/33.1	.209/33.1	.218/33.1	.226/24.2	.231/20.9	.233/20.9	.232/20.3	.228/20.3	.223/18.5	.219/20.9	.218/20.9
	21	.205/33.1	.207/33.1	.211/33.1	.218/33.1	.225/33.1	.231/24.2	.235/24.2	.237/20.9	.236/20.9	.234/20.9	.230/20.9	.227/20.9	.226/20.9
30	7	.033/20.3	.042/20.3	.061/11.2	.081/11.2	.094/11.2	.109/ 7.9	.114/ 7.9	.111/ 7.9	.102/ 7.9	.087/ 7.9	.067/ 7.9	.046/ 8.3	.036/ 9.0
	9	.063/20.3	.071/20.3	.092/20.3	.116/20.3	.138/20.3	.155/20.3	.164/ 9.2	.165/ 9.5	.157/ 9.5	.142/10.5	.122/10.5	.104/10.8	.096/10.8
	11	.099/28.6	.104/28.6	.121/20.3	.143/20.3	.164/20.3	.182/20.3	.193/20.3	.197/11.6	.192/11.6	.181/11.6	.167/11.6	.154/11.6	.149/11.6
	13	.129/34.9	.134/34.9	.147/34.9	.165/20.6	.183/20.6	.199/20.6	.210/20.3	.214/14.0	.211/14.0	.204/14.0	.194/14.0	.185/12.6	.182/12.6
	15	.154/34.9	.158/34.9	.168/34.9	.182/34.9	.197/34.9	.211/20.6	.220/20.6	.224/15.7	.223/15.7	.218/15.7	.211/15.7	.205/15.7	.202/15.7
	17	.173/34.9	.176/34.9	.184/34.9	.195/34.9	.207/34.9	.218/34.9	.226/20.3	.230/18.0	.230/18.0	.226/18.0	.221/18.0	.216/18.0	.215/18.0
	19	.188/39.3	.190/39.3	.196/39.3	.205/34.9	.214/34.9	.223/34.9	.219/20.9	.233/20.9	.234/20.9	.231/20.9	.226/20.9	.224/20.9	.223/20.9
	21	.200/39.3	.201/39.3	.206/39.3	.213/39.3	.221/34.9	.228/34.9	.234/20.6	.237/20.9	.237/20.9	.236/20.9	.233/20.9	.231/20.9	.230/20.9

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 11 - RMS VERTICAL VELOCITY AT STATION 15 MAIN DECK IN SHORT-CRESTED SEAS

CSGN - CONVENTIONAL HULL

SHORTCRESTED

RMS VER VEL IN FPS/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

STATION 15 - 166.5 FT FROM AP AND 51.5 FT ABOVE BL

V	T	SHIP HEADING ANGLE IN DEGREES												
	0	0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.051/ 7.5	.059/ 7.5	.077/ 7.3	.095/ 7.0	.110/ 7.0	.119/ 7.0	.121/ 7.0	.116/ 7.0	.105/ 7.0	.089/ 7.3	.070/ 7.3	.052/ 7.5	.044/ 7.5
	9	.070/10.5	.077/ 9.0	.093/ 9.5	.110/ 9.0	.125/ 8.5	.134/ 8.5	.137/ 8.5	.132/ 8.5	.121/ 9.0	.105/ 9.0	.087/ 9.5	.071/10.5	.064/10.5
	11	.085/11.6	.090/11.6	.102/11.2	.115/11.2	.127/10.8	.135/10.8	.137/10.8	.133/10.8	.124/10.8	.112/11.2	.098/11.2	.086/11.6	.082/11.6
	13	.094/12.6	.097/12.6	.105/12.6	.115/12.6	.124/12.1	.129/12.1	.131/12.1	.128/12.1	.122/12.6	.112/12.6	.102/12.6	.094/12.6	.091/12.6
	15	.096/14.0	.098/14.0	.104/14.0	.111/14.0	.117/14.0	.122/14.0	.123/14.0	.121/14.0	.116/14.0	.109/14.0	.102/14.0	.097/14.0	.095/14.0
	17	.094/15.7	.096/15.7	.100/15.7	.105/15.7	.110/15.7	.113/15.7	.114/15.7	.113/15.7	.109/15.7	.104/15.7	.099/15.7	.095/15.7	.093/15.7
	19	.091/18.0	.092/18.0	.095/18.0	.099/15.7	.103/15.7	.105/15.7	.106/15.7	.105/15.7	.102/15.7	.098/15.7	.094/18.0	.091/18.0	.090/18.0
	21	.087/18.0	.088/18.0	.090/18.0	.093/18.0	.096/18.0	.098/18.0	.098/18.0	.097/18.0	.095/18.0	.092/18.0	.089/18.0	.087/18.0	.086/18.0
5	7	.039/ 8.7	.047/ 9.3	.066/ 7.5	.085/ 7.3	.101/ 7.1	.111/ 7.0	.115/ 7.0	.112/ 7.0	.102/ 7.0	.088/ 7.3	.071/ 7.3	.055/ 7.5	.047/ 7.9
	9	.054/12.1	.061/11.6	.079/ 9.0	.098/ 9.2	.114/ 9.0	.125/ 9.0	.130/ 9.0	.128/ 9.0	.119/ 9.0	.106/ 9.0	.090/ 9.5	.076/10.5	.070/10.5
	11	.068/13.4	.073/13.1	.086/12.0	.102/12.1	.116/11.6	.126/11.2	.131/11.2	.130/10.8	.124/11.2	.113/11.2	.101/11.6	.091/11.6	.087/11.6
	13	.076/14.3	.080/14.3	.090/14.0	.102/13.7	.113/13.1	.121/12.6	.126/12.6	.126/12.6	.122/12.6	.115/12.6	.107/12.6	.100/12.6	.097/12.6
	15	.080/15.7	.083/15.7	.090/15.7	.099/15.3	.108/14.6	.115/14.0	.119/14.0	.120/14.0	.117/14.0	.112/14.0	.107/14.0	.102/14.0	.101/14.0
	17	.080/17.5	.082/17.5	.087/17.0	.094/16.5	.102/15.7	.107/15.7	.111/15.7	.112/15.7	.110/15.7	.107/15.7	.104/15.7	.101/15.7	.099/15.7
	19	.074/19.0	.080/19.0	.084/18.5	.089/18.0	.095/18.0	.100/17.5	.103/17.0	.104/16.5	.103/16.5	.101/18.0	.099/18.0	.097/18.0	.096/18.0
	21	.076/19.6	.077/19.6	.080/19.6	.084/19.6	.089/19.0	.093/18.5	.096/18.0	.097/18.0	.097/18.0	.095/18.0	.094/18.0	.092/18.0	.092/18.0
10	7	.024/12.0	.030/ 8.1	.050/ 7.5	.077/ 7.3	.094/ 7.3	.105/ 7.3	.110/ 7.3	.108/ 7.3	.101/ 7.3	.088/ 7.3	.072/ 7.5	.057/ 7.9	.050/ 7.9
	9	.042/13.4	.050/13.4	.060/10.5	.089/ 9.0	.106/ 9.0	.119/ 9.0	.126/ 9.0	.125/ 9.0	.119/ 8.7	.107/ 8.5	.093/ 8.5	.080/10.5	.076/10.5
	11	.054/15.7	.060/15.7	.075/15.3	.092/12.0	.108/11.6	.120/11.2	.127/11.2	.128/11.2	.124/11.2	.115/11.2	.105/11.6	.095/11.6	.091/11.6
	13	.061/17.0	.067/16.5	.078/16.5	.092/15.7	.105/14.0	.116/12.0	.123/12.6	.125/12.6	.123/12.6	.117/12.6	.110/12.6	.104/12.6	.102/12.6
	15	.76[illegible]	.070/18.0	.078/17.5	.089/[illegible]	.101/15.7	.110/15.0	.116/14.0	.119/14.0	.118/14.0	.115/14.0	.111/14.0	.107/14.0	.105/14.0
	17	.068/19.6	.071/19.0	.077/19.2	.086/18.0	.095/17.5	.103/16.1	.109/15.7	.112/15.7	.112/15.7	.110/15.7	.108/15.7	.105/15.7	.106/15.7
	19	.069/20.9	.069/20.3	.076/19.6	.082/19.6	.089/18.5	.096/18.0	.101/18.0	.104/18.0	.105/18.0	.104/18.0	.103/18.0	.101/18.0	.101/18.0
	21	.066/21.7	.068/21.7	.072/21.7	.077/20.9	.084/20.9	.090/19.6	.096/18.5	.097/18.0	.098/18.0	.098/18.0	.097/18.0	.097/18.0	.096/18.0
15	7	.021/14.3	.032/ 8.5	.052/ 7.5	.072/ 7.3	.089/ 7.3	.101/ 7.3	.107/ 7.3	.106/ 7.3	.099/ 7.5	.086/ 7.5	.071/ 7.5	.055/ 7.9	.047/ 7.9
	9	.037/17.5	.041/17.5	.061/ 9.2	.083/ 9.0	.102/ 9.0	.116/ 8.5	.124/ 8.5	.126/ 8.5	.120/ 8.5	.109/ 8.5	.096/ 8.5	.088/ 8.5	.076/10.5
	11	.044/20.3	.050/20.3	.066/20.3	.085/12.1	.103/11.6	.117/11.2	.126/10.8	.129/10.8	.126/11.2	.118/11.2	.107/11.6	.097/11.6	.093/11.6
	13	.051/20.3	.056/20.3	.069/20.3	.084/15.3	.100/13.4	.113/12.6	.122/12.6	.126/12.6	.125/12.6	.120/12.6	.114/12.6	.107/12.6	.105/12.6
	15	.056/20.9	.060/20.9	.069/20.3	.082/20.3	.095/15.7	.107/15.3	.115/14.0	.120/14.0	.121/14.0	.118/14.0	.114/14.0	.111/14.0	.109/14.0
	17	.058/21.7	.061/21.7	.068/21.7	.079/20.9	.090/18.0	.100/17.5	.108/15.7	.112/15.7	.114/15.7	.114/15.7	.112/15.7	.109/15.7	.108/15.7
	19	.055/23.3	.060/22.4	.066/22.4	.075/21.7	.084/20.9	.093/18.0	.100/18.0	.105/18.0	.107/18.0	.108/18.0	.107/18.0	.105/18.0	.105/18.0
	21	.054/24.2	.059/24.2	.064/24.2	.071/22.4	.079/21.7	.087/20.9	.093/19.6	.098/18.0	.101/18.0	.101/18.0	.101/18.0	.101/18.0	.100/18.0
20	7	.015/13.4	.020/13.4	.040/ 7.1	.069/ 7.3	.086/ 7.3	.098/ 7.3	.105/ 7.3	.104/ 7.5	.098/ 7.5	.086/ 7.5	.069/ 7.9	.053/ 7.9	.044/ 8.3
	9	.026/19.0	.035/19.0	.056/ 9.0	.079/ 9.0	.100/ 9.0	.116/ 9.0	.126/ 9.0	.129/ 9.0	.125/ 9.0	.114/ 9.0	.099/ 9.0	.084/ 9.0	.078/10.5
	11	.035/23.3	.042/23.3	.060/23.3	.081/11.2	.101/10.8	.117/10.8	.128/10.8	.133/10.8	.132/10.8	.125/10.8	.115/11.2	.105/11.6	.101/11.6
	13	.047/23.3	.047/23.3	.061/23.3	.079/14.6	.097/14.0	.112/12.6	.124/12.6	.130/12.6	.131/12.6	.127/12.6	.121/12.6	.115/12.6	.113/12.6
	15	.046/26.2	.051/26.2	.062/26.2	.076/23.3	.092/15.7	.106/14.6	.116/14.0	.123/14.0	.126/14.0	.125/14.0	.122/14.0	.118/14.0	.117/14.0
	17	.049/26.2	.052/26.2	.061/26.2	.073/26.2	.086/19.0	.098/15.7	.108/15.7	.115/15.7	.119/15.7	.119/15.7	.118/15.7	.116/15.7	.115/15.7
	19	.053/27.3	.052/27.3	.059/27.3	.070/26.2	.081/23.3	.092/19.0	.101/18.0	.107/18.0	.111/18.0	.113/18.0	.113/18.0	.112/18.0	.111/18.0
	21	.053/27.3	.052/27.3	.058/27.3	.066/27.3	.076/23.3	.085/20.9	.094/19.6	.100/18.0	.104/18.0	.106/18.0	.107/18.0	.106/18.0	.106/18.0
25	7	.014/16.5	.026/16.5	.046/16.5	.067/16.5	.084/ 7.3	.097/ 7.5	.104/ 7.5	.104/ 7.9	.097/ 7.9	.085/ 7.9	.069/ 7.9	.051/ 7.9	.042/ 8.5
	9	.021/16.5	.031/16.5	.053/16.5	.077/16.5	.100/ 8.7	.116/ 9.0	.130/ 9.0	.135/ 9.0	.132/ 9.0	.122/ 9.2	.104/ 9.0	.096/10.5	.087/10.5
	11	.029/16.5	.036/16.5	.055/16.5	.078/16.5	.100/10.8	.120/10.5	.134/10.5	.142/10.5	.143/10.5	.138/10.8	.130/10.8	.121/10.8	.117/10.8
	13	.034/33.1	.040/33.1	.055/33.1	.075/16.5	.096/12.6	.114/12.6	.128/12.6	.138/12.1	.141/12.1	.140/12.1	.136/12.1	.131/12.1	.129/12.1
	15	.034/33.1	.043/33.1	.055/33.1	.072/16.5	.090/16.5	.106/14.0	.120/14.0	.130/14.0	.135/14.0	.136/14.0	.135/14.0	.132/14.0	.131/14.0
	17	.041/33.1	.045/33.1	.055/33.1	.069/33.1	.084/16.5	.099/16.5	.111/16.5	.121/15.7	.126/15.7	.129/15.7	.129/15.7	.128/15.7	.128/15.7
	19	.042/33.1	.045/33.1	.053/33.1	.065/33.1	.078/18.0	.091/18.0	.103/18.0	.112/18.0	.118/18.0	.121/18.0	.122/18.0	.122/18.0	.122/18.0
	21	.043/33.1	.046/33.1	.052/33.1	.062/33.1	.074/24.2	.085/20.3	.095/18.5	.103/18.0	.109/18.0	.113/18.0	.115/18.0	.115/18.0	.115/18.0
30	7	.013/18.0	.024/18.0	.045/ 7.0	.065/ 7.3	.083/ 7.5	.096/ 7.9	.103/ 7.9	.103/ 7.9	.097/ 7.9	.085/ 7.9	.068/ 7.9	.050/ 8.3	.040/ 9.0
	9	.017/20.3	.020/20.3	.051/12.1	.077/ 8.3	.101/ 8.5	.121/ 8.5	.134/ 9.0	.140/ 9.2	.139/ 9.2	.130/ 9.5	.117/10.5	.103/10.5	.097/10.8
	11	.023/20.3	.031/20.3	.052/20.3	.076/20.3	.101/10.5	.123/10.5	.141/10.5	.152/10.5	.156/10.8	.154/10.8	.140/11.2	.141/11.2	.138/11.2
	13	.027/20.6	.034/20.6	.051/20.3	.073/20.3	.096/12.6	.117/12.6	.135/11.6	.148/11.2	.155/11.6	.157/11.6	.156/11.6	.153/11.6	.152/11.6
	15	.031/34.9	.037/34.9	.050/34.9	.069/20.6	.089/14.0	.109/14.0	.126/14.0	.139/14.0	.147/14.0	.152/12.6	.153/12.1	.152/12.1	.152/12.1
	17	.034/34.9	.038/34.9	.049/34.9	.065/34.9	.083/20.3	.100/15.7	.116/15.7	.128/15.7	.137/15.7	.142/15.7	.145/15.7	.145/15.7	.145/15.7
	19	.036/34.9	.039/34.9	.048/34.9	.062/34.9	.077/20.3	.092/20.3	.106/18.0	.118/18.0	.126/18.0	.132/18.0	.135/18.0	.136/18.0	.136/18.0
	21	.037/39.3	.040/39.3	.040/39.3	.059/34.9	.072/34.9	.085/20.3	.098/20.3	.108/18.0	.117/18.0	.122/18.0	.126/18.0	.127/18.0	.128/18.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

BLANK

APPENDIX A

PROGRAM TABL

The TABL program prints the long-crested or short-crested rms ship responses contained in the CSGN01 disk pack, or it can use those values to compute and print significant single amplitude motions. The output format is a table with the appropriate values printed as a function of speed, modal period, and heading. The significant responses are calculated by using the formula:

$$X = C_T \cdot (\tilde{\zeta}_w)_{1/3} \cdot \sigma$$

where X = the significant value

C_T = the confidence factor, defined as 2.0 for single amplitudes

$(\tilde{\zeta}_w)_{1/3}$ = the significant wave height

σ = the rms response for unit significant wave height

The input card format controls the type and extent of the output of the program prints. The following is a listing of the data sets required:

INPUT

Data Card Set 1, one card, FORMAT (I1)

This card set contains one integer variable

IFLAG, Column 1, is used to determine whether long-crested or short-crested values are to be printed:

IFLAG = 1, for long-crested values

IFLAG = 2, for short-crested values

Data Card Set 2, one card, FORMAT (I1)

This card set contains one integer variable

ITEST, Column 1, is used to determine whether rms or significant single amplitude values are to be printed:

ITEST = 0, for rms values

ITEST > 0, for significant values

NOTE. Data card sets 3 and 4 are repeated for each point on the ship desired (i.e., those previously defined for the rms calculations). The first point is defined as the origin.

<u>Data Card Set 3</u>, one card, FORMAT (I1)

This card set contains one integer variable

NMOT, Column 1, is used to determine the total number of motions to be read in Data Card Set 4 and can have a value of from 0 to 3 for all points except the origin; at the origin (point one), NMOT can have a value of from 0 to 6 corresponding to the additional 3 angular motions which are computed only at the origin.

NOTE: Data Card Set 4 is not included if NMOT = 0.

<u>Data Card Set 4</u>, from one to six cards, FORMAT (4I5)

This card set contains four integer variables

(1) MOT, Column 5, is used to define the desired motion; MOT = 1, 2, 3, 4, 5, and 6 correspond to the motions of surge, sway, heave, roll, pitch, and yaw, respectively; roll, pitch, and yaw are defined only at the origin (point one)

(2) T(I) is used to define the type of motion desired; T = 1, 2, and 3 correspond to displacement, velocity, and acceleration, respectively

NOTE: Card Sets 5 and 6 are included only when significant responses are desired (ITEST 0)

<u>Data Card Set 5</u>, one card, FORMAT (I1)

This card set contains one integer variable

NSW, Column 1, is used to determine the number of significant wave heights to be read in Data Card Set 6

<u>Data Card Set 6</u>, one card, FORMAT (8F10.4)

This card set contains the NSW values of significant wave height, SWH(I), used in computing the significant responses

NOTE: Data Card Set 7 is included only when motions other than at the origin are desired.

Data Card Set 7, from one to (NP-1)* cards, FORMAT (8A10)

This car set contains the alphanumeric information describing the individaul point locations

PTNAM (array), Columns 1-80

A sample of the entire computer card deck necessary to access the disk pack and run the program is shown in Figure A.1. The sample data is set up to generate a table of long-crested significant values for all motions, velocities, and accelerations on the disk.

*(NP-1) refers to the total number of point locations excluding the origin (point one).

Figure A.1 - Sample of TABL Program with Control Cards and Data

```
CHTA,CM77777,T1000,P3.                                        APPLEBEE, 1568
CHARGE,CHTA,
PAUSE.   JOB REQUIRES DISK PACK  DV4750
MOUNT,VSN=DV4750,SN=CSGN01.
ATTACH,TAPE9,CSGN17TAPE9,ID=CHTA,SN=CSGN01,MR=1.
FTN,A,T,R=3,OPT=2,PL=50000.
DISPOSE,OUTPUT,PR=C.
LGO.
0000000000000000000000  END OF RECORD
      PROGRAM TABL (INPUT=512,OUTPUT=512,TAPE5=INPUT,TAPE6=OUTPUT,
     2 TAPE9=512)
      INTEGER T,T1,T2,T3
      DIMENSION PTNAM(50,8),TMOT1(12),TMOT2(12),TMOT3(12),IHEAD(13)
      DIMENSION TITL(12),V(8),SIGWH(8),T0(8),IT0(8),KV(8)
      DIMENSION XAP(50),YCL(50),ZBL(50),DBLWL(50),XSTAR(50),YSTAR(50),
     2 ZSTAR(50)
      DIMENSION RMSL(13),TOEL(13),RMSS(13),TOES(13),RMS2ML(13),
     2 RMS4ML(13),RMS2MS(13),RMS4MS(13)
      DIMENSION RMSTBL(13,8,8),TOETBL(13,8,8)
      DIMENSION NMOT(51),M(6),T1(6),T2(6),T3(6),T(3,6,51),MOT(6,51)
      DIMENSION SWH(8),TMOT4(12),TMOT5(12),TMOT6(12),EXTTBL(13,8,64)
      DATA TMOT1 /10HRMS LON DI,10HSP IN FEET,
     2            10HRMS LAT DI,10HSP IN FEET,
     2            10HRMS VER DI,10HSP IN FEET,
     2            10H RMS ROLL ,10HIN DEGREES,
     2            10HRMS PITCH ,10HIN DEGREES,
     2            10H  RMS YAW ,10HIN DEGREES/
      DATA TMOT2 /10H  RMS LON ,10HVEL IN FPS,
     2            10H  RMS LAT ,10HVEL IN FPS,
     2            10H  RMS VER ,10HVEL IN FPS,
     2            10H RMS ROLL ,10HVEL IN DPS,
     2            10HRMS PITCH ,10HVEL IN DPS,
     2            10H  RMS YAW ,10HVEL IN DPS/
      DATA TMOT3 /10H  RMS LON ,10HACC IN G'S,
     2            10H  RMS LAT ,10HACC IN G'S,
     2            10H  RMS VER ,10HACC IN G'S,
     2            10H RMS ROLL ,10HACC IN DS2,
     2            10HRMS PITCH ,10HACC IN DS2,
     2            10H  RMS YAW ,10HACC IN DS2/
      DATA TMOT4 /10HEXT LON DI,10HSP IN FEET,
     2            10HEXT LAT DI,10HSP IN FEET,
     2            10HEXT VER DI,10HSP IN FEET,
     2            10H EXT ROLL ,10HIN DEGREES,
     2            10HEXT PITCH ,10HIN DEGREES,
     2            10H  EXT YAW ,10HIN DEGREES/
      DATA TMOT5 /10H  EXT LON ,10HVEL IN FPS,
     2            10H  EXT LAT ,10HVEL IN FPS,
     2            10H  EXT VER ,10HVEL IN FPS,
     2            10H EXT ROLL ,10HVEL IN DPS,
     2            10HEXT PITCH ,10HVEL IN DPS,
     2            10H  EXT YAW ,10HVEL IN DPS/
      DATA TMOT6 /10H  EXT LON ,10HACC IN G'S,
     2            10H  EXT LAT ,10HACC IN G'S,
     2            10H  EXT VER ,10HACC IN G'S,
     2            10H EXT ROLL ,10HACC IN DS2,
     2            10HEXT PITCH ,10HACC IN DS2,
     2            10H  EXT YAW ,10HACC IN DS2/
      CT = 2.0
      READ (9) TITL,NV,V,NS,SIGWH,T0,NP,NM,NT,TPST,ELL,(XAP(I),YCL(I),
     2 ZBL(I),DBLWL(I),XSTAR(I),YSTAR(I),ZSTAR(I),I=1,NP)
      DO 2 I=1,NS
```

```
2   ITO(I) = TO(I)+.001
    DO 3 I=1,NV
3   KV(I) = V(I)+.001
    WRITE (6,3000) NP,NM,NT,NV,NS
    READ (5,1000) IFLAG
    READ (5,1000) ITEST
    WRITE (6,3005)
    DO 5 IP=1,NP
    READ (5,1000) NMOT(IP)
    WRITE (6,3010) IP,NMOT(IP)
    NMT = NMOT(IP)
    IF (NMT.EQ.0) GO TO 5
    DO 4 I=1,NMT
    READ (5,1010) MOT(I,IP),(T(J,I,IP),J=1,3)
    WRITE (6,3020) MOT(I,IP),(T(J,I,IP),J=1,3)
4   CONTINUE
5   CONTINUE
    IF (ITEST.GT.0) GO TO 6
    IF (IFLAG.EQ.1) WRITE(6,3030)
    IF (IFLAG.EQ.2) WRITE(6,3040)
    GO TO 7
6   READ (5,1000) NSW
    READ (5,1025) (SWH(L),L=1,NSW)
    WRITE (6,1050) NSW,(SWH(L),L=1,NSW)
    IF (ITEST.EQ.1) WRITE(6,3050)
    IF (ITEST.EQ.2) WRITE(6,3060)
7   DO 300 IP=1,NP
    NMT = NMOT(IP)
    IF (NMT.EQ.0) GO TO 8
    L = IP-1
    IF (IP.GT.1) READ(5,1020) (PTNAM(L,J),J=1,8)
8   IF (IP.GT.1) NM=3
9   DO 200 IM=1,NM
    DO 100 IT=1,NT
    J1 = 1
    KFLAG = 0
    DO 60 IV=1,NV
    IW = 0
    DO 50 IS=1,NS
    READ (9) (RMSL(I),TOEL(I),RMSS(I),TOES(I),RMS2ML(I),RMS4ML(I),
   2 RMS2MS(I),RMS4MS(I),I=1,13)
    IF (NMT.EQ.0) GO TO 50
    IF (ITEST.LE.0) NSW=1
    DO 49 ISW=1,NSW
    IW = IW+1
    DO 45 I=1,NMT
    M(I) = MOT(I,IP)
    T1(I) = T(1,I,IP)
    T2(I) = T(2,I,IP)
    T3(I) = T(3,I,IP)
    IF (M(I).NE.IM) GO TO 45
    IF (T1(I).NE.IT.AND.T2(I).NE.IT.AND.T3(I).NE.IT) GO TO 45
    KFLAG = 1
    KM = I
    DO 40 K=1,13
    GO TO (10,20),IFLAG
10  RMSTBL(K,IV,IS) = RMSL(K)
    TOETBL(K,IV,IS) = TOEL(K)
    GO TO 30
20  RMSTBL(K,IV,IS) = RMSS(K)
    TOETBL(K,IV,IS) = TOES(K)
30  IF (IM.LE.3.AND.IT.EQ.3) RMSTBL(K,IV,IS) = RMSTBL(K,IV,IS)*100.
    IF (ITEST.LE.0) GO TO 36
    EXTTBL(K,IV,IW) = CT*SWH(ISW)*RMSTBL(K,IV,IS)
36  IHEAD(K) = (K-1)*15
40  CONTINUE
```

```
45    CONTINUE
49    CONTINUE
50    CONTINUE
60    CONTINUE
      IF (NMT.EQ.0) GO TO 100
      IF (KFLAG.EQ.0) GO TO 100
      NN = M(KM)*2
      MM = NN-1
      IF (ITEST.GT.0) GO TO 80
      IF (IFLAG.EQ.2) GO TO 62
      IF (IT.EQ.1) WRITE(6,2000) TITL,TMOT1(MM),TMOT1(NN)
      IF (IT.EQ.2) WRITE(6,2000) TITL,TMOT2(MM),TMOT2(NN)
      IF (IT.EQ.3) WRITE(6,2000) TITL,TMOT3(MM),TMOT3(NN)
      GO TO 65
62    IF (IT.EQ.1) WRITE(6,2001) TITL,TMOT1(MM),TMOT1(NN)
      IF (IT.EQ.2) WRITE(6,2001) TITL,TMOT2(MM),TMOT2(NN)
      IF (IT.EQ.3) WRITE(6,2001) TITL,TMOT3(MM),TMOT3(NN)
65    IF (IM.LE.3.AND.IT.EQ.3) WRITE(6,2010)
      IF (IP.GT.1) WRITE(6,2020) (PTNAM(L,J),J=1,8)
      WRITE (6,2030) (IHEAD(N),N=1,13)
      DO 75 IV=1,NV
      WRITE (6,2040) KV(IV),ITO(1),(RMSTBL(K,IV,1),TOETBL(K,IV,1),
     2 K=1,13)
      IF (NS.LE.1) GO TO 75
      DO 70 IS=2,NS
70    WRITE (6,2050) ITO(IS),(RMSTBL(K,IV,IS),TOETBL(K,IV,IS),K=1,13)
75    CONTINUE
      WRITE (6,2060)
      GO TO 99
80    DO 97 ISW=1,NSW
      IF (ITEST.EQ.2) GO TO 85
      IF (IT.EQ.1) WRITE(6,2000) TITL,TMOT4(MM),TMOT4(NN)
      IF (IT.EQ.2) WRITE(6,2000) TITL,TMOT5(MM),TMOT5(NN)
      IF (IT.EQ.3) WRITE(6,2000) TITL,TMOT6(MM),TMOT6(NN)
      WRITE (6,1500) SWH(ISW)
      GO TO 90
85    IF (IT.EQ.1) WRITE(6,2001) TITL,TMOT4(MM),TMOT4(NN)
      IF (IT.EQ.2) WRITE(6,2001) TITL,TMOT5(MM),TMOT5(NN)
      IF (IT.EQ.3) WRITE(6,2001) TITL,TMOT6(MM),TMOT6(NN)
      WRITE (6,1500) SWH(ISW)
90    IF (IM.LE.3.AND.IT.EQ.3) WRITE(6,2010)
      IF (IP.GT.1) WRITE(6,2020) (PTNAM(L,J),J=1,8)
      WRITE (6,2030) (IHEAD(N),N=1,13)
      DO 95 IV=1,NV
      IW = J1+NSW
      WRITE (6,2045) KV(IV),ITO(1),(EXTTBL(K,IV,J1),TOETBL(K,IV,1),
     2 K=1,13)
      IF (NS.LE.1) GO TO 95
      DO 93 IS=2,NS
      WRITE (6,2045) ITO(IS),(EXTTBL(K,IV,IW),TOETBL(K,IV,IS),K=1,13)
93    IW = IW+NSW
95    CONTINUE
      WRITE (6,2060)
97    J1 = J1+1
99    CONTINUE
100   CONTINUE
200   CONTINUE
300   CONTINUE
      STOP
1000  FORMAT (I1)
1010  FORMAT (4I5)
1020  FORMAT (8A10)
1025  FORMAT (8F10.4)
1050  FORMAT (*0*,///,42X,*THE*I2* SIGNIFICANT WAVE HEIGHTS USED TO CALC
     2ULATE*,/,42X,*THE EXTREME RESPONSES ARE*,//,8(62X,F10.2,* FT*,/))
1500  FORMAT (/,48X,*AT A SIGNIFICANT WAVE HEIGHT OF *,F6.2)
```

```
2000  FORMAT (1H1,31X,12A6//,61X,*LONGCRESTED*/,36X,2A10,*/ENCOUNTERED M
     2ODAL PERIOD, T   , IN SECONDS*/84X,*OE*)
2001  FORMAT (1H1,31X,12A6//,61X,*SHORTCRESTED*/,36X,2A10,*/ENCOUNTERED
     2MODAL PERIOD, T   , IN SECONDS*/84X,*OE*)
2010  FORMAT (61X,*(ACC. X 100)*)
2020  FORMAT (28X,8A10)
2030  FORMAT (/2X,*V*,1X,*T*,51X,*SHIP HEADING ANGLE IN DEGREES*/5X,*0*,
     2 5X,I2,12(7X,I3))
2040  FORMAT (/2(1X,I2),13(F5.3,*/*,F4.1))
2045  FORMAT (/2(1X,I2),13(F5.1,*/*,F4.1))
2046  FORMAT (   (4X,I2),13(F5.1,*/*,F4.1))
2050  FORMAT (   (4X,I2),13(F5.3,*/*,F4.1))
2060  FORMAT (/33X,*NOTE!  V IS SHIP SPEED IN KNOTS AND T  IS MODAL WAVE
     2 PERIOD IN SECONDS.*/70X,*0*)
3000  FORMAT (*1*,5X,*NP =*,I5,/6X,*NM =*,I5,/6X,*NT =*,I5,/6X,*NV =*,
     2 I5,/6X,*NS =*,I5)
3005  FORMAT (*0*,/,5X,*NOTE MOTION VALUES-  SURGE = 1*,20X,*NOTE TYPE V
     2ALUES-  DISPLACEMENT = 1*,/26X,*SWAY  = 2*,39X,*VELOCITY'    = 2*,
     3/26X,*HEAVE = 3*,39X,*ACCELERATION = 3*,/26X,*ROLL  = 4*,/26X,*PIT
     4CH = 5*,/26X,*YAW   = 6*)
3010  FORMAT (*0*,//,5X,*AT POINT*,I3,*, THE NUMBER OF MOTIONS =*,I2)
3020  FORMAT (*0*,5X,*MOTION =*,I5,10X,*TYPES =*,3I5)
3030  FORMAT (*1*,/////,41X,*THE FOLLOWING TABLES ARE THE LONGCRESTED RM
     2S VALUES*)
3040  FORMAT (*1*,/////,40X,*THE FOLLOWING TABLES ARE THE SHORTCRESTED R
     2MS VALUES*)
3050  FORMAT (*1*,/////,30X,*THE FOLLOWING TABLFS ARE THE LONGCRESTED SI
     2NGLE AMPLITUDE EXTREME VALUES*)
3060  FORMAT (*1*,/////,30X,*THE FOLLOWING TABLES ARE THE SHORTCRESTED S
     2INGLE AMPLITUDE EXTREME VALUES*)
      END
0000000000000000000000     END OF RECORD
1
1
6
    1    1    2    3
    2    1    2    3
    3    1    2    3
    4    1    2    3
    5    1    2    3
    6    1    2    3
3
    1    1    2    3
    2    1    2    3
    3    1    2    3
3
    1    1    2    3
    2    1    2    3
    3    1    2    3
3
    1    1    2    3
    2    1    2    3
    3    1    2    3
3
    1    1    2    3
    2    1    2    3
    3    1    2    3
3
10.2       16.9       30.6
               STATION 3 - 566.1 FT FROM AP AND 51.0 FT ABOVE BL
PILOT HOUSE (STATION 8) - 399.6 FT FROM AP, 10.0 FT OFF CL, AND 90.0 FT ABOVE BL
               STATION 15 - 166.5 FT FROM AP AND 51.5 FT ABOVE BL
                    AFT PERPENDICULAR - 43.5 FT ABOVE BL
0000000000000000000000  END OF FILE
```

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APPENDIX B
PROGRAM RED

The PHM program was modified just for this project to store the irregular wave rms values of absolute motion velocity and acceleration and the relative motion and velocity for all ship locations of interest. A small program was written to pick up the rms stored values and compute the number of occurrences of deck wetness or sonar dome window emergence and keel slamming for any significant wave height. The PHM program has the capability of making these predictions but is not very efficient when a variety of sea spectra are under consideration.

The program uses the theory developed by Ochi[7] to predict the number of occurrences of deck wetness and slamming. No allowance is made in the calculations for either trim or sinkage of the ship since this information is not available from the motion prediction programs.

INPUT

Card 1, Format (I5, F7.2)

NSIG - Number of significant wave heights to be input

SL - Ship length (feet)

Card 2, Format (8F10.2)

H(K) - Vertical distance (feet) the the point at the Kth station requested in the PHM program where the number of occurrences of slamming is to be determined

FRE(K) - Vertical distance (feet) to the point at the Kth station where the number of occurrences of deck wetness or sonar dome emergence is to be determined

Alternate values of H(K) and FRE(K) up to a maximum of 8 values on a card

Input H(K) or FRE(K) = 0 if not desired

Card 3, Format (8F10.2)

SIGWH(JJ) - Significant wave heights (feet)

A sample of the input cards is shown in Figure B.1.

OUTPUT

A sample of the output is shown in Figure B.2 for 30.60-ft significant wave height and 30.0-knot ship speed. Each output matrix has columns associated with the sea spectra with modal period as listed in the beginning of each row. The numbers in the table are the number of slams per hour, etc. for each combination of station and sea spectra.

CONTROL CARDS

A listing of the control cards is shown in Figure B.3. The program as well as the rms data are stored on the disk. A complete listing of the program is shown in Figure B.4.

```
 + 656.00
  22.15      34.80      31.83      22.15      29.65      32.50      22.15      28.80
  23.50      30.00      40.00      50.00
0000000000000000000000   END OF RECORD
 + 656.00
  22.50      35.10      32.18      22.50      30.00      33.12      22.50      28.70
  23.50      30.00      40.00      50.00
0000000000000000000000   END OF FILE
```

Figure B.1 - Sample Input to Program RED

1 PITCH-HEAVE MOTIONS IN HEAD SEAS CSGN DATA BASE FOR CONVENSIONAL HULL 6/76

STATION NUMBER	0.00	.50	1.00	3.00
DRAFT	22.15	31.43	29.65	22.15
FREEBOARD	34.80	22.15	32.80	28.80

SLAMS PER HOUR

SHIP SPEED IS 30.00 KTS SIGNIFICANT WAVE HEIGHT IS **30.60 FT**

WAVE PERIOD	ST 0.0	.5	1.0	3.0
9.00	109	12	21	96
11.00	241	92	108	175
13.00	252	117	128	165
15.00	218	95	102	121
17.00	168	61	65	71

CONTACTS PER HOUR

SHIP SPEED IS 30.00 KTS SIGNIFICANT WAVE HEIGHT IS **30.60 FT**

WAVE PERIOD	ST 0.0	.5	1.0	3.0
9.00	6	137	11	25
11.00	88	292	94	96
13.00	124	304	122	107
15.00	108	272	101	78
17.00	74	224	66	43

Figure B.2 - Sample Output of Program RED

```
CHLMRED,CM70000,T40,P3,RP1.
CHARGE,CHLM,1156886302,CC,K.
PAUSE.  JOB REQUIRES DISK PACK DV4752
MOUNT,VSN=DV4752,SN=CSGN02.
ATTACH,TAPE3,RMSCONVRBMPHM,ID=CHTA,SN=CSGN02.
MAP(OFF)
FTN(D)
LGO,PL=20000.
RETURN,TAPE3.
ATTACH,TAPE3,RMSLWPRBMPHM,ID=CHTA,SN=CSGN02.
LGO.
0000000000000000000000  END OF RECORD
```

Figure B.3 - Sample of Control Cards for Program RED

Figure B.4 - Listing of Program RED

```
      PROGRAM  RED(INPUT,OUTPUT,TAPE6=OUTPUT,TAPE5=INPUT,TAPE2,TAPE3)
  400 FORMAT(I5,F7.2)
  401 FORMAT(8F10.2)
 500  FORMAT(1H1,9A10)
 601  FORMAT(1H1,5X,2HWE,8X,1HW,6X,16HHEAVE TF    PHASE ,4X,
     . 16HPITCH TF    PHASE)
 602  FORMAT(9H    NSP  =,I4,26H  =  NUMBER OF SHIP SPEEDS //
     .9H    NFRS =,I4,35H  =  NUMBER OF FREQUENCIES COMPUTED //
     . 9H    NST  =,I4,56H  =  NUMBER OF STATIONS FOR VERTICAL MOTION COM
     .PUTATIONS // 9H    NWH   ,I4,58H  =  NUMBER OF WAVE HEIGHTS FOR IRR
     .EGULAR SEA COMPUTATIONS   )
 603  FORMAT(6F10.3)
  604 FORMAT(1H1,20X,14HSTATION NUMBER,F7.2/16X,2HWE,6X,7HABS MOT ,
     . 5X,3HRBM/)
 605  FORMAT(10X,3F10.3)
  607  FORMAT(////40X,14HSLAMS PER HOUR // 20X,14HSHIP SPEED IS ,F8.2,
     . 4H KTS,10X,27HSIGNIFICANT WAVE HEIGHT IS ,F8.2,3H FT//
     . 7X,11HWAVE PERIOD, 3X,2HST,F5.1,9F10.1)
  608  FORMAT(F15.2,4I10)
  609 FORMAT(////40X,17HCONTACTS PER HOUR//20X,14HSHIP SPEED IS ,F8.2,
     . 4H KTS,10X,27HSIGNIFICANT WAVE HEIGHT IS ,F8.2,3H FT//
     . 7X,11HWAVE PERIOD, 3X,2HST,F5.1,9F10.1)
 610  FORMAT(10X,14HSTATION NUMBER,10F8.2//)
  611 FORMAT(19X,5HDRAFT,10F8.2//)
  612 FORMAT(15X,9HFREEBOARD,10F8.2//)
      DIMENSION H(10), FRE(10), SIGWH(10), NSLAMS(6,10,10),NIMP(6,10,10)
      DIMENSION TITLE(9),VKT(6),WE(51),W(51),HEAVE(51),
     .HPHASE(51),PITCH(51),PPHASE(51),TAM(51,10),TRM(51,10)
       DIMENSION RD(6,5,10),RV(6,5,10),     AD(6,5,10),
     . AV(6,5,10), AA(6,5,10), SWH(5),APN(5),STM(10)
      READ(5,400)   NSIG,SL
      NRW = 0
      IF (NRW.NE.1)  GO TO 110
      READ(2)     TITLE,NFRS,NSP,NST,NWH
  110 READ(3)     TITLE,NFRS,NSP,NST,NWH, STM, SWH, APN
      READ(5,401)   (H(K),FRE(K), K=2,NST)
      READ(5,401)   (SIGWH(JJ), JJ=1,NSIG)
      H(1) = 0.0
      FRE(1) = 0.0
      THRVEL = .526234*SQRT(SL)
       DO 100 I =1,NSP
      READ (3) VKT(I),                           ((AD(I,J,K),AV(I,J,K),
     . AA(I,J,K), RD(I,J,K),RV(I,J,K), K=1,NST), J=1,NWH)
      IF (NRW.NE.1)  GO TO 300
      READ(2)         VKT(I),                 (WE(N),W(N),HEAVE(N),HPHASE(N)
     2 , PITCH(N),PPHASE(N), (TAM(N,K), TRM(N,K),K=1,NST), N =1,NFRS)
      WRITE(6,500)   (TITLE(M), M=1,9)
      WRITE(6,602)   NSP,NFRS,NST,NWH
      WRITE(6,601)
      WRITE(6,603)  (WE(N),W(N),HEAVE(N),HPHASE(N),PITCH(N),PPHASE(N),
     .N =1,NFRS)
            DO 200 K=1,NST
      WRITE(6,604)     STM(K)
       WRITE(6,605)  ( WE(N), TAM(N,K), TRM(N,K), N=1,NFRS)
  200 CONTINUE
  300 WRITE(6,500)   (TITLE(M), M=1,9)
      WRITE(6,610)   (STM(K), K=2,NST)
      WRITE(6,611)   (H(K), K=2,NST)
      WRITE(6,612)   (FRE(K), K=2,NST)
         DO 80 JJ=1,NSIG
         DO 70 J=1,NWH
         DO 60    K=2,NST
      RVAR = 2.*(SIGWH(JJ)*RD(I,J,K))**2
      RDUT = 2.*(SIGWH(JJ)*RV(I,J,K))**2
      ENCPHR = 572.97 *SQRT(RDUT/RVAR)
      SLAEXP = H(K)**2/RVAR + THRVEL**2/RDUT
      FXPIMP = FRE(K)**2/RVAR
      IF(SLAEXP.GT.10.0)   GO TO 57
      IF(H(K).EQ.0.0)   GO TO 57
  56  NSLAMS(I,J,K) = ENCPHR*EXP(-(SLAEXP))
      GO TO 58
  57  NSLAMS(I,J,K) = 0
  58  IF(EXPIMP.GT.10.0)   GO TO 59
      IF(FRE(K).EQ.0.0)   GO TO 59
      NIMP(I,J,K) = ENCPHR * EXP(-(EXPIMP))
      GO TO 60
  59  NIMP(I,J,K) = 0
   60  CONTINUE
   70  CONTINUE
      WRITE(6,607)   VKT(I), SIGWH(JJ), (STM(K), K=2,NST)
      WRITE(6,608)   (APN(J), (NSLAMS(I,J,K), K=2,NST), J=1,NWH)
      WRITE(6,609)   VKT(I),SIGWH(JJ), (STM(K), K=2,NST)
      WRITE(6,608)   (APN(J), (NIMP(I,J,K), K=2,NST), J=1,NWH)
   80  CONTINUE
  100  CONTINUE
      END
```

```
      PROGRAM  RED(INPUT,OUTPUT,TAPE6=OUTPUT,TAPE5=INPUT,TAPE2,TAPE3)
  400 FORMAT(I5,F7.2)
  401 FORMAT(8F10.2)
 500  FORMAT(1H1,9A10)
 601  FORMAT(1H1,5X,2HWE,8X,1HW,6X,16HHEAVE TF    PHASE ,4X,
     . 16HPITCH TF   PHASE)
 602  FORMAT(9H   NSP  =,I4,26H  =  NUMBER OF SHIP SPEEDS //
     .9H   NFRS =,I4,35H  =  NUMBER OF FREQUENCIES COMPUTED //
     . 9H   NST  =,I4,56H  =  NUMBER OF STATIONS FOR VERTICAL MOTION COM
     .PUTATIONS // 9H   NWH   ,I4,58H  =  NUMBER OF WAVE HEIGHTS FOR IRR
     .EGULAR SEA COMPUTATIONS  )
 603  FORMAT(6F10.3)
  604 FORMAT(1H1,20X,14HSTATION NUMBER,F7.2/16X,2HWE,6X,7HABS MOT ,
     . 5X,3HRBM/)
 605  FORMAT(10X,3F10.3)
  607  FORMAT(////40X,14HSLAMS PER HOUR // 20X,14HSHIP SPEED IS ,F8.2,
     . 4H KTS,10X,27HSIGNIFICANT WAVE HEIGHT IS ,F8.2,3H FT//
     . 7X,11HWAVE PERIOD, 3X,2HST,F5.1,9F10.1)
  608  FORMAT(F15.2,4I10)
  609 FORMAT(////40X,17HCONTACTS PER HOUR//20X,14HSHIP SPEED IS ,F8.2,
     . 4H KTS,10X,27HSIGNIFICANT WAVE HEIGHT IS ,F8.2,3H FT//
     . 7X,11HWAVE PERIOD, 3X,2HST,F5.1,9F10.
 610  FORMAT(10X,14HSTATION NUMBER,10F8.2//)
  611 FORMAT(19X,5HDRAFT,10F8.2//)
  612 FORMAT(15X,9HFREEBOARD,10F8.2//)
      DIMENSION H(10), FRE(10), SIGWH(10), NSLAMS(6,10,10),NIMP(6,10,10)
      DIMENSION TITLE(9),VKT(6),WE(51),W(51),HEAVE(51),
     .HPHASE(51),PITCH(51),PPHASE(51),TAM(51,10),TRM(51,10)
       DIMENSION RD(6,5,10),RV(6,5,10),    AD(6,5,10),
     . AV(6,5,10), AA(6,5,10), SWH(5),APN(5),STM(10)
      READ(5,400)  NSIG,SL
      NRW = 0
      IF (NRW.NE.1)  GO TO 110
      READ(2)    TITLE,NFRS,NSP,NST,NWH
  110 READ(3)    TITLE,NFRS,NSP,NST,NWH, STM, SWH, APN
      READ(5,401)  (H(K),FRE(K), K=2,NST)
      READ(5,401)  (SIGWH(JJ), JJ=1,NSIG)
      H(1) = 0.0
      FRE(1) = 0.0
      THRVEL = .526234*SQRT(SL)
       DO 100 I =1,NSP
      READ (3) VKT(I),                         ((AD(I,J,K),AV(I,J,K),
     . AA(I,J,K), RD(I,J,K),RV(I,J,K), K=1,NST), J=1,NWH)
      IF (NRW.NE.1)  GO TO 300
      READ(2)        VKT(I),                 (WE(N),W(N),HEAVE(N),HPHASE(N)
     2 , PITCH(N),PPHASE(N), (TAM(N,K), TRM(N,K),K=1,NST), N =1,NFRS)
      WRITE(6,500)   (TITLE(M), M=1,9)
      WRITE(6,602)  NSP,NFRS,NST,NWH
      WRITE(6,601)
      WRITE(6,603)  (WE(N),W(N),HEAVE(N),HPHASE(N),PITCH(N),PPHASE(N),
     .N =1,NFRS)
             DO 200 K=1,NST
      WRITE(6,604)     STM(K)
       WRITE(6,605)  ( WE(N), TAM(N,K), TRM(N,K), N=1,NFRS)
  200 CONTINUE
  300 WRITE(6,500)   (TITLE(M), M=1,9)
      WRITE(6,610)   (STM(K), K=2,NST)
      WRITE(6,611)   (H(K), K=2,NST)
      WRITE(6,612)   (FRE(K), K=2,NST)
         DO 80 JJ=1,NSIG
         DO 70 J=1,NWH
         DO 60   K=2,NST
      RVAR = 2.*(SIGWH(JJ)*RD(I,J,K))**2
      RDOT = 2.*(SIGWH(JJ)*RV(I,J,K))**2
      ENCPHR = 572.97 *SQRT(RDOT/RVAR)
      SLAEXP = H(K)**2/RVAR + THRVEL**2/RDOT
      EXPIMP = FRE(K)**2/RVAR
      IF(SLAEXP.GT.10.0)  GO TO 57
      IF(H(K).EQ.0.0)  GO TO 57
  56  NSLAMS(I,J,K) = ENCPHR*EXP(-(SLAEXP))
      GO TO 58
  57  NSLAMS(I,J,K) = 0
  58  IF(EXPIMP.GT.10.0)  GO TO 59
      IF(FRE(K).EQ.0.0)  GO TO 59
      NIMP(I,J,K) = ENCPHR * EXP(-(EXPIMP))
      GO TO 60
  59  NIMP(I,J,K) = 0
   60  CONTINUE
   70  CONTINUE
      WRITE(6,607)   VKT(I), SIGWH(JJ), (STM(K), K=2,NST)
      WRITE(6,608)   (APN(J), (NSLAMS(I,J,K), K=2,NST), J=1,NWH)
      WRITE(6,609)   VKT(I),SIGWH(JJ), (STM(K), K=2,NST)
      WRITE(6,608)   (APN(J), (NIMP(I,J,K), K=2,NST), J=1,NWH)
   80  CONTINUE
  100  CONTINUE
      END
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REFERENCES

1. Meyers, W.G. et al., "Manual - NSRDC Ship-Motion and Sea-Load Computer Program," NSRDC Report 3376 (Feb 1975).

2. St Denis, M., and W.J. Pierson, "On the Motions of Ships in Confused Seas," Trans Soc. Nav. Arch. Mar. Eng., Vol. 61, pp. 280-357 (1953).

3. Bretschneider, C L., "Wave Generation by Wind, Deep and Shallow Water," in "Estuary and Coastline Hydrodynamics," edited by Arthur T, Ippen, McGraw-Hill, Inc., (1966) pp. 133-196.

4. Baitis, A.E. et al., "Design Acceleration and Ship Motions for LNG Cargo Tanks," presented at 10th Naval Hydrodynamics Symposium, Mass. Inst. Technol. (Jun 1974).

5. Frank, W and N. Salvesen, "The Frank Close-Fit Ship Motion Computer Program," NSRDC Report 3289 (Jun 1970).

6. Hubble, E.N. and J.B. Hadler, "Prediction of Ship Motions in Regular and Irregular Head Waves," NSRDC Departmental Report SPD-623-01 (Apr 1975).

7. Ochi, M.K., "Prediction of Occurrence and Severity of Ship Slamming at Sea," presented at Fifth Symposium on Naval Hydrodynamics, Norway (Sep 1964).

8. Hogben, N and F E Lumb, "Ocean Wave Statistics," Her Majesty's Stationery Office, London (1967).

9. Nordenström, N., "Methods for Predicting Long Term Distributions of Wave Loads and Probability of Failure for Ships, APP II," Det Norske Veritas Research Department Report 69-22-S (1969).

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